Scientific and Technical Aerospace Reports

A SEMIMONTHLY ABSTRACT JOURNAL WITH INDEXES

JANUARY 23, 1965

VOLUME 3 • NUMBER 2

N65-10956 — N65-12334

DOCUMENTS

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Scientific and Technical Aerospace Reports, Volume 3, is prepared by the Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget December 20, 1962

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Scientific and Technical Information Division
National Aeronautics and Space Administration

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VOLUME 3 NUMBER 2

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-10979# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany) Institut für Aerodynamik
INVESTIGATIONS ON VORTEX BREAKDOWN ON SLENDER DELTA WINGS [UNTERSUCHUNGEN UBER DAS AUFPLATZEN DER WIRBEL AN SCHLANKEN DELTAFLUGELN]
D. Hummel Aug. 1964 38 p refs In GERMAN; ENGLISH summary Presented at the Ann. Meeting of the WGLR, Berlin, 14–18 Sep. 1964 *Its* Rept.-64-27
(DLR-FB-64-12) Available from ZLDI, Munich: DM 8

The results of experimental investigations on vortex breakdown on slender delta wings are presented. The phenomenon of vortex breakdown has been investigated by measuring the flow field over a delta wing of aspect ratio $\Lambda = 0.78$. The results are compared with the stability theory. In order to determine the effect of vortex breakdown on the aerodynamic characteristics of a wing, six component measurements and pressure-distribution measurements on a delta wing of aspect ratio $\Lambda = 1.0$ have been carried out. The forces and moments decrease when the vortexes break down just above the wing. Author

N65-10993 Aeronautical Research Inst. of Sweden, Stockholm
MEMO REGARDING SCATTER IN SONIC-BOOM INTENSITIES
Bo Lundberg 3 May 1963 5 p refs
(FFAP-GD-155)

This is a statistical analysis of the scatter in boom overpressure from data gathered by several recording instruments arranged on a straight line perpendicular to the flight path, and also by a recording located under the flight path. All experimental results were adjusted for airplane size, Mach number, and altitude, and were compared to the theoretical values of peak overpressure under ideal conditions. A standard deviation of 30% in the overpressure distribution was calculated from the comparisons, and the flight profiles were established. It was found that the boom overpressure for a Mach 2.2, 220 000 SST will reach a maximum of about 3.0 lbs/sq ft during climb, and a level of 2.5 lbs/sq ft in cruise at an average frequency of 1 in 100. G.G.

N65-11005 Gt. Brit. Ministry of Aviation, London
ROUGHNESS CRITERIA AND DRAG PENALTIES FOR BANDS OF DISTRIBUTED ROUGHNESS ON TWO SLENDER WINGS AT SUPERSONIC SPEEDS
D. G. Mabey 1964 27 p refs Supersedes RAE-TN-Aero-2885, ARC-24844
(ARC-CP-738; RAE-TN-Aero-2885; ARC-24844) HMSO: 5s

The variation of zero-lift-drag coefficient with Reynolds number is used to determine the effectiveness of bands of distributed roughness on two slender wings at supersonic speeds. Results show that the roughness height required to insure fully turbulent flow up to the position of roughness increases rapidly with Mach number ($M = 1.4$ to 2.0) and that the roughness drag penalties may be significant. Wing planform and camber both influence roughness effectiveness. Author

N65-11093# Princeton U., N.J.
A WIND-TUNNEL INVESTIGATION OF THE EFFECTS OF LEADING-EDGE BLOWING JETS UPON THE LIFT, DRAG, AND PITCHING MOMENT OF A 76° DELTA WING
Chester J. Gabriel Jul. 1964 65 p refs
(Contract Nonr-1858(14))
(Rept.-697; AD-603904)

A wind-tunnel investigation was made of the effects of leading-edge blowing jets in the plane of the planform and directed away from the wing, upon the lift, drag, and pitching moment of a 76° delta wing of aspect ratio one. A theory for the lift of a flat plate delta is presented and compared with the experimental data. It was found that V_j/U_∞ is a better parameter than C_μ for the analysis of lift data with the type of blowing jet configuration used. Lift coefficient increased appreciably with blowing at low values of C_μ and V_j/U_∞, and then tended to level off as blowing was increased. At low angles-of-attack, the only additional drag induced by blowing was the momentum drag due to the rearward thrust of the jets. It was found that such blowing reduced the stability of the wing. Author

N65-11137# RAND Corp., Santa Monica, Calif.
BLUNTNESS AND VISCOUS-INTERACTION EFFECTS ON SLENDER BODIES AT HYPERSONIC SPEEDS

C. F. Dewey, Jr. Sep. 1964 104 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3832-PR; AD-605249) OTS: $4.00

This memorandum is concerned with the aerodynamic design and performance of slender vehicles operating in high-altitude, high-velocity environments. A brief description of the pertinent regimes of flight is presented, and arguments are advanced to show that at high altitudes, the leading-edge thickness is not dictated by convective and radiative heat-transfer rates. The flight regimes where leading-edge bluntness and hypersonic viscous interaction are important are described, and a summary of the theoretical approaches to these two limiting cases is given. The parameter defining the relative importance of bluntness and viscous effects is approximately equal to 1.1 $\sqrt{(\lambda_\infty/t)}(x/t)^{1/6}$, where λ_∞ is the ambient mean free path, t is the leading-edge thickness, and x is the streamwise distance from the leading edge. A method of computing skin friction, heat transfer, and surface pressure in the viscous-interaction regime is outlined. Author

N65-11308*# National Aeronautics and Space Administration, Washington, D.C.
CALCULATION OF FLOW AROUND THE LOWER SURFACE OF DELTA WINGS AT WIDE ANGLES OF ATTACK [RASCHET TECHENIYA OKOLO NIZHNEY POVERKHNOSTI TREUGOL'NYKH KRYL'YEV PRI BOL'SHIKH UGLAKH ATAKI]
A. P. Bazzhin Nov. 1964 11 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 4, no. 2, 1964 p 242–246
(NASA-TT-F-9163) OTS Prices: HC $1.00/MF $0.50

The method of integral relations in the first approximation is used for calculating the flow near the lower surface of delta wings streamlined by a supersonic flow of gas at wide angles-of-attack. Some results are cited. Author

N65-11341*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF CANOPY SHAPE ON LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A 55° SWEPT PARAWING WITH LARGE-DIAMETER LEADING EDGES
Delwin R. Croom, Rodger L. Naeseth, and William C. Sleeman, Jr. Washington, NASA, Dec. 1964 100 p refs
(NASA-TN-D-2551) OTS Prices: HC $3.00/MF $0.75

A low-speed wind-tunnel investigation was conducted to study effects of wing-canopy shape on the aerodynamic characteristics and spreader-bar load of a 55° swept parawing having large-diameter leading edges and keel. The canopy-flat-pattern sweep angles investigated on the 55° swept wing were 42.5°, 45°, 47.5°, 50°, and 52.5°. Several other modifications to the canopy shape were also studied, such as removal of single, double, and compound gores from the rear part of each canopy lobe. A study of the effects of wing-leading-edge sweep angle was made between sweep angles of 50° and 60°, and effects of leading-edge diameter were obtained at the basic 55° sweep angle. Effects of keel web height were determined for a constant trailing-edge length and also for trailing-edge lengths that varied with web height. Author

N65-11438# Aberdeen Proving Ground, Md. Ballistic Research Lab.
WIND TUNNEL TESTS OF RECTANGULAR FINNED VARIABLE GAP TANGENT OGIVE-CYLINDER MODEL AT MACH NUMBERS 1.75 TO 4.50
Neil A. Zarin Aug. 1964 97 p
(BRL-MEMO-1583; AD-451304)

Three different rectangular-shaped fin planforms were tested at varying body-to-fin distances. The configurations were tested over the Mach number range 1.75 to 4.50, at a constant Reynolds number. A check for Reynolds number dependence was also made. The pitching moment, normal force and drag coefficients and the center of pressure were determined for angles-of-attack from −4° to +8°. The results are presented and summarized. Author

N65-11481# Vehicle Research Corp., Pasadena, Calif.
A LIFTING SURFACE THEORY FOR WINGS EXTENDING THROUGH MULTIPLE JETS IN SEPARATED FLOW CONDITIONS
E. Cumberbatch and T. Yao-Tsu Wu 22 Oct. 1963 35 p refs
(Contract Nonr-2388(00))
(Rept.-10; AD-602502)

A lifting surface theory for wing–propeller slipstream interactions in separated flow conditions has been developed. The case where the flow over wing portions immersed in the propeller slipstreams (jets) is attached while the flow over the wing outside the jets is separated has been treated in detail. The case where flow is separated both inside and outside the jets may be analyzed in a similar manner. The theoretical development combines nonseparated flow analyses, based on the Rethorst lifting surface solution, with cavitation (separated flow) theory, developed by Wu and Wang. The formulation parallels that developed for multiple jets by Wu and Talmadge. A lifting surface representation based on a generalization of Weissinger's approximation was developed. In the separated flow regions, the location of the lifting line and the station where downwash boundary conditions must be satisfied are determined from cavitation theory and/or experimental results. Author

N65-11599# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ANALYSIS OF LOW-FREQUENCY PULSATIONS IN GAS-TURBINE COMBUSTION CHAMBERS
O. V. Dubrovskiy 28 May 1964 17 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 8, 1961 p 32–37
(FTD-MT-63-209; AD-606765)

An experimental analysis of low-frequency temperature and pressure pulsations in the flame zones of the combustion chambers of stationary gas-turbine installations was conducted with the help of specially designed equipment. The probable causes of the origin of these pulsations are established. Author

N65-11706# Minnesota U., Minneapolis Inst. of Technology
THEORETICAL PARACHUTE INVESTIGATIONS Progress Report, 1 Sep.–30 Nov. 1961
H. G. Heinrich et al [1961] 29 p refs
(Contract AF 33(616)-8310)
(PR-19; AD-603723)

Summaries of progress in the following investigations are presented: (1) "Investigation of Wake Effects on the Behavior of Parachutes and Other Retardation Devices behind Large Bodies at Subsonic and Supersonic Speeds"; (2) "Investigation of Basic Stability Parameters of Conventional Parachutes"; (3) "Theoretical Study of Supersonic Parachute Phenomena"; (4) "Theoretical Analysis of the Dynamics of the Opening Parachute"; (5) "Statistical Analysis of Extraction Time, Deployment Time, Opening Time, and Drag Coefficient for Aerial Delivery Parachutes and Systems"; (6) "Study of Basic Principles of New Parachutes and Retardation Devices"; (7) "Gliding Aerodynamic Decelerator"; (8) "Ribbon Grids for Supersonic Flow"; (9) "Study of Flow Patterns of Aerodynamic

Decelerators by Means of the Surface Wave Analogy"; and (10) "Stress Analysis of the T-10 Troop Parachute." P.V.E.

N65-11754# Aerospace Corp., El Segundo, Calif.
SEPARATED FLOW PAST SLENDER DELTA WINGS WITH SECONDARY VORTEX SIMULATION
Bernard Pershing 24 Aug. 1964 55 p refs
(Contract AF 04(695)-269)
(TDR-269(4560-10)-4; SSD-TDR-64-151; AD-607442)

The flow about a slender flat-plate delta wing at angle-of-attack is represented by replacing the vortex core-feeding sheet system associated with leading-edge separation by a force-free concentrated vortex. Secondary-flow phenomena near the leading edge are approximated by allowing infinite flow velocity around the leading edge. The problem is reduced to a two-dimensional one by assuming a conical field and using slender wing theory. Computed pressure and lift distribution, vortex position, lift coefficient, and flow patterns are compared with test data and with the theories of Brown and Michael, and Mangler and Smith. The nonlinear characteristics of the lift curve with angle-of-attack, and the strong influence of secondary flow simulation on vortex position and pressure distribution are displayed. The vortex is shown to be further inboard than predicted by previous theories and to correlate well with experiment. The nonlinear component of lift, the pressure distribution, and the surface flow pattern are also shown to correlate well with experiment. Author

N65-11756# Naval Postgraduate School, Monterey, Calif.
GAS TURBINE REGENERATOR FOULING INVESTIGATION
First Quarterly Progress Report
N. L. Kohler and J. A. Miller 15 Oct. 1964 26 p
(TR-21; AD-607895)

A report on the progress of an experimental investigation of fouling effects in compact gas-turbine regenerator matrices is presented. Fouling effects on heat-transfer rates, and pressure-drop characteristics for a number of matrix geometries and two-exhaust gas temperatures are presented. Preliminary results indicate gas side-surface temperature, and gas composition as the primary parameters with geometric effects occupying a lesser role. The effect of fouling on pressure-drop characteristics is found to be more pronounced than the effect on heat transfer. Author

N65-11906*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LARGE-SCALE WIND-TUNNEL TESTS ON AN ASPECT RATIO 2.17 DELTA-WING MODEL EQUIPPED WITH MIDCHORD BOUNDARY-LAYER-CONTROL FLAPS
David G. Koenig and Victor R. Corsiglia Washington, NASA, Dec. 1964 67 p refs
(NASA-TN-D-2552) OTS Prices: HC $3.00/MF $0.75

The wing-fuselage model had midchord flaps that were 10% and 15% of the wing chord with hinge lines located along the 60% and 55% chord lines, respectively. Both flaps extended from 17% to 57% of the wing span. Deflecting the flaps left a cutout in the wing with the flap planform outline. For midchord flap deflections more than 30°, blowing boundary-layer control was applied to the knee of the flap. The wing was also equipped with full-span constant-chord leading-edge flaps and partial-span 15% trailing-edge flaps, which were deflected alone and in combination with the midchord flaps. Tests were made in and out of ground effect at zero sideslip over an angle-of-attack range of −2° to +22°. The Reynolds number for the tests was 13.7×10^6, and the Mach number was 0.10. Author

N65-11914# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
HANDBOOK OF SUPERSONIC AERODYNAMICS. SECTION 17: DUCTS, NOZZLES AND DIFFUSERS
Lester L. Cronvich and Ione D. V. Faro Washington, Bur. of Naval Weapons, Jan. 1964 440 p refs
(Contract NOw-62-0604-c)
(NAVWEPS-1488, Vol. 6; AD-418060) GPO: $3.25

This handbook presents subjects and tables selected on the basis of anticipated usefulness to all who are concerned with the design and performance of supersonic vehicles. The following topics are discussed: "Duct Flow Theory"; "Supersonic Inlets"; "Wind-Tunnel Nozzles"; "Supersonic Wind-Tunnel Diffusers"; and "Propulsion Nozzles." G.G.

N65-11915# Royal Aeronautical Society, London (Gt. Brit.)
DATA SHEETS: AERODYNAMICS, VOLUME 1
Jul. 1963 202 p refs

This is a presentation of theoretical and practical aerodynamic data sheets for the convenient use of aircraft designers. The data were gathered from a large number of technical reports by correlation and checking of the different conclusions of the evaluation sources. A subject index is included. G.G.

N65-11916# Royal Aeronautical Society, London (Gt. Brit.)
DATA SHEETS: AERODYNAMICS, VOLUME 2
Dec. 1962 110 p refs

This study contains aerodynamic data sheets pertaining to the geometrical and theoretical properties of various forms of wings. Information on the use of these data sheets for the wing series 02.04 is also included. G.G.

N65-11918# Royal Aeronautical Society, London (Gt. Brit.)
DATA SHEETS: AERODYNAMICS, VOLUME 4
Dec. 1962 163 p refs

This is a collection of aerodynamic data sheets pertaining to the bodies, various controls, and the flaps of aircraft. Information on the use of these data sheets for split and slotted flaps and for the body series 02.04 is included. G.G.

N65-11954# Southampton U. (Gt. Brit.)
DETERMINATION OF THE FORCES MOMENTS ON AN AEROFOIL OSCILLATING THROUGH THE STALL Annual Technical Report No. 1, Jan. 1963–Dec. 1963
J. P. Jones Jan. 1964 36 p refs
(Contract DA-91-591-EUC-2772)
(AASU-252; AD-447110)

The fluctuating pressures on the surface of an airfoil model that increased its incidence from below to above the stall were observed. It was found that the effect of the Reynolds number is of great importance, that the flow separation is delayed by the oscillation, and that there are very sharp peaks in the local pressure just before separation. A new, hybrid computer method for solving the blade-motion equations, in the calculation of blade motion when stall occurs, has been developed. G.G.

N65-12099# Northrop Corp., Hawthorne, Calif. Norair Div.
SUMMARY OF LAMINAR BOUNDARY LAYER CONTROL RESEARCH, VOLUME II
Wright-Patterson AFB, Ohio, ASD, Mar. 1964 411 p refs
(Contract AF 33(616)-7564)
(ASD-TDR-63-554; AD-605186) OTS: $8.85

Low-drag boundary-layer suction experiments on a 41-inch-long flat plate were conducted in a 40- by 40-inch continuous supersonic tunnel. The model was equipped with 76 closely spaced fine slots arranged in eight suction chambers. Full-length laminar flow was obtained at M = 2.5, 3.0, and 3.5 up to the highest possible tunnel pressures, resulting in length Reynolds numbers of 21.8×10^6, 25.7×10^6, and 21.4×10^6, respectively. The measured drag coefficients (sum of wake and suction drag) were of the order of 26% to 43% of the turbulent friction drag at the same Reynolds and Mach numbers. The results of calculations of the laminar boundary-layer development along the plate at typical suction distributions are compared with the test data. Author

N65-12134# Bell Aerosystems Co., Buffalo, N.Y.
MEASUREMENT OF ANGULAR DISPLACEMENTS OF PRACTICAL WING STRUCTURES BY THE MOIRE FRINGE TECHNIQUE
Joseph Padlog and Richard H. Gallagher Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1964 56 p refs
(Contract AF 33(657)-7486)
(FDL-TDR-64-42; AD-608470)

Results of a study of the feasibility of employing the Moiré fringe technique in the measurement of angular displacements of practical wing structures are presented. Slope influence coefficients obtained from Moiré fringe patterns determined from a square cantilever plate and a swept wing model are compared with available theoretical and experimental data. Author

N65-12138# Minnesota U., Minneapolis
DRAG COEFFICIENTS OF SEVERAL BODIES OF REVOLUTION AT TRANSONIC AND SUPERSONIC VELOCITY
H. G. Heinrich, Sheldon R. Hess, and Gunar Stumbris Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1964 52 p refs
(Contract AF 33(616)-8310)
(ASD-TDR-63-663; AD-608303)

The drag coefficients of several bodies of revolution, which are significant for the purpose of aerodynamic deceleration, were measured in the transonic flow regime and at supersonic speeds of Mach 4 and 5. Author

N65-12186# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
STATIC AERODYNAMIC CHARACTERISTICS AT MACH 5 AND 8 OF AN AERODYNAMICALLY CONTROLLABLE WINGED RE-ENTRY CONFIGURATION. PART OF AN INVESTIGATION OF HYPERSONIC FLOW SEPARATION AND CONTROL CHARACTERISTICS
Lawrence Meckler Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1963 156 p refs
(Contract AF 33(616)-8130)
(FDL-TDR-64-10; AD-608304)

Six-component aerodynamic data were obtained at Mach 5 and 8 for a winged reentry configuration having aerodynamic controls. The basic model consisted of a clipped delta wing with an overslung body. The main controls tested were a deflected apex and partial-span trailing-edge flaps. Data were also obtained on the effect of tip fins, full-span trailing-edge flap, and trailing-edge spoiler. At Mach 5 the data were obtained over an angle-of-attack range from $-30°$ to $+45°$ at a unit Reynolds number of 2.26×10^6 At mach 8 the angle-of-attack range was $-54°$ to $+54°$ at the same unit Reynolds number. Author

N65-12294# Aeronautical Research Labs., Melbourne (Australia)
AN EXPERIMENTAL INVESTIGATION OF A CASCADE DESIGNED FOR BOUNDARY LAYER SUCTION
Murdoch Culley Aug. 1963 19 p refs
(ARL/ME-258)

An investigation was conducted into the practicability of using blade boundary-layer suction to obtain high turning angles in a cascade. The cascade, designed to incorporate a suction region on the upper surface, was installed in a low-speed cascade tunnel, and determinations were made of blade-profile drag, pump work, flow deflection angle, and static-pressure rise. The anticipated low drag and high turning angles were achieved, but high secondary flow losses resulted in a relatively low pressure rise through the cascade. Author

N65-12306*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
USE OF ARBITRARY QUASI-ORTHOGONALS FOR CALCULATING FLOW DISTRIBUTION IN THE MERIDIONAL PLANE OF A TURBOMACHINE
Theodore Katsanis Washington, NASA, Dec. 1964 48 p refs
(NASA-TN-D-2546) OTS Prices: HC $2.00/MF $0.50

A method of analyzing flow through a turbomachine is presented that is suitable for computer programing. It is assumed that a mean stream surface from hub to shroud between blades is known. On this stream surface a two-dimensional solution for the velocity and pressure distributions is obtained, and then an approximate calculation of the blade surface velocities is made. This method is based on an equation for the velocity gradient along an arbitrary quasi-orthogonal rather than the normal to the streamline as used in previous methods. With this new method a solution can be obtained in a single computer run, even for cases where the distance between hub and shroud is great and there is a change in direction from radial to axial within the rotor. The method was successfully applied to a turbine with this type of geometry. These results are given as a numerical example, and the FORTRAN computer program is included. Author

N65-12312*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METHODS OF DETERMINING THE TRANSONIC FLOW FIELD IN AN AXIALLY SYMMETRIC ROCKET NOZZLE Interim Report
R. S. Mendelson 6 Jul. 1964 17 p refs
(NASA-TM-X-53084) OTS Prices: HC $3.00/MF $0.75

Since flow becomes supersonic in the vicinity of the throat of the nozzle, analysis of the transonic flow in the throat region is of interest. The physical problem was approximated by a steady-state axisymmetric system (coordinates x and y) with zero radial velocity along the axis. In this region, the fluid is considered to be a homogeneous, perfect gas in frozen equilibrium with no viscous forces. The system is also considered irrotational and isentropic with negligible energy losses through the nozzle surface. In the region of the throat, the nozzle surface is expressed as a power series in terms of the axial coordinate and is not limited to boundary surfaces of constant radius of curvature for the minimum section. This method attempts to solve the full, nonlinear potential equation of motion. A double power series in both x and y is assumed for the potential function. The original equation is satisfied by recurrence relationships for the general coefficients that are evaluated in terms of the coefficients of the velocity distribution along the axis. The remaining coefficients are determined by satisfying the inviscid boundary condition along the nozzle contour, where the contour is described by a power series in x. Author

N65-12313*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CALCULATION OF TRANSONIC NOZZLE FLOW
Joseph L. Sims 12 Oct. 1964 25 p refs
(NASA-TM-X-53081) OTS Prices: HC $1.00/MF $0.50

An approximate solution of the transonic throat flow in a DeLaval nozzle is found by expanding the potential function in a power series about the critical line. Five terms were used in the present series expansion, and the complete potential flow equation of motion was used. Solutions of the present set of equations are functions of two independent parameters—the radius of curvature of the nozzle wall and the ratio of specific heats of the fluid medium. The solution of the resultant equations is complex enough to make an electronic computer program desirable. For this reason, basic results of a series of solutions over a wide range of the two independent parameters are given in tabular form. From these tabulated results, any quantities of interest in the flow may be rapidly computed. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-11012# Naval Ordnance Test Station, China Lake, Calif. Weapons Development Dept.
DEVELOPMENT OF AIRCRAFT PROTECTIVE COATING AGAINST ROCKET MOTOR EXHAUSTS
Roland E. Baker and John G. Badenhope Jun. 1964 33 p
(NAVWEPS-8479; NOTS-TP-3443; AD-445949)

This report describes the development of an aircraft protective coating against rocket motor exhausts. Tests using the Mk 31 Mod 0 Sidewinder motor indicated that a coating with Q-3-0121 silicone rubber provided adequate protection for aircraft surfaces. This coating is eroded at the rate of 0.010 to 0.015 in. on the leading edge of the wing droop when a Mk 31 Mod 0 rocket motor is fired from the upper starboard launcher of the F-8D or F-8E aircraft at high altitude and low speed. No erosion could be detected during low-altitude or on high-speed firings. Author

N65-11071# Eidgenössisches Flugzeugwerk Emmen (Switzerland)
THE FATIGUE SAFETY OF AIRCRAFT IN SERVICE AND ITS SUPERVISION IN THE VIEW OF F + W EMMEN
Jürg Branger [1964] 24 p refs Presented at the 2nd Seminar on Fatigue and Fatigue Design, Columbia U., N.Y., 5 May 1964
(S-164)

The fatigue safety of an aircraft in service is ascertained by simulating its service fatigue life in a full-scale test on the ground. The key of the problem's solution is a test facility capable of simulating the genuine sequence of the loads occurring in service. A scheme is detailed for all work that has to be done before, during, and after the test, including the evolution of the history loading program. Special inspection methods are mentioned, and an example of the displaying method is described. A method to estimate the factor of safety and its influences is proposed. Author

N65-11094# Aviation Safety Engineering and Research, Phoenix, Ariz.
PERSONNEL RESTRAINT SYSTEM STUDY, CV-2 DeHAVILLAND CARIBOU. CRASH INJURY EVALUATION, SUPPLEMENT
Ft. Eustis, Va., Army Transportation Res. Command, Apr. 1964 24 p
(Contract DA-44-177-AMC-888(T))
(TRECOM-TR-64-3, Suppl.; AD-606887)

This supplement consists of the engineering drawings of personnel restraint harness and its installation in the CV-2 DeHavilland Caribou. R.L.K.

N65-11289# Eidgenössisches Flugzeugwerk Emmen (Switzerland)
THE FULL SCALE FATIGUE TEST ON THE DH-112 VENOM AC CARRIED OUT ON THE FATIGUE HISTORY SIMULATOR BY F + W EMMEN
Jürg Branger 20 Apr. 1964 20 p refs Presented at the 2d Seminar on Fatigue and Fatigue Design, Columbia U., N.Y., 5 May 1964
(S-163)

The test rig, the statistics of fatigue loads, the evolution of the test program for the history loading, and two successful test runs of 5000 hours are described, as well as the inspection methods. The service aircraft could be cleared for a safe life of 1200 hours. Author

N65-11290# Eidgenössisches Flugzeugwerk Emmen (Switzerland)
THE FULL SCALE FATIGUE TEST P 3 CARRIED OUT ON THE FATIGUE HISTORY SIMULATOR BY F + W EMMEN
Jürg Branger 20 Apr. 1964 14 p refs Presented at the 2nd Seminar on Fatigue and Fatigue Design, Columbia U., N.Y., 5 May 1964
(S-162; ICAF-284)

In the specification of the Pilatus P3 trainer aircraft a safe life of 2500 hours is required. Therefore, the aircraft was tested on a fatigue history simulator. The evolution of the loading program, the construction of the test rig, the inspection methods, the test run, and the results are reported. After a fatigue test run of 5000 hours the test specimen failed in an ultimate load test at 90% of the design ultimate load. This was due to fatigue failures that were not detected previously. Author

N65-11328# France Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux
THE KINETIC HEATING OF A SCHEMATIC MODEL OF A SUPERSONIC TRANSPORT AIRCRAFT [L'ECHAUFFEMENT CINETIQUE D'UNE MAQUETTE SCHEMATIQUE D'AVION DE TRANSPORT SUPERSONIQUE]
Rene Ceresuela, Roger Marguet, and Xavier Vaucheret [1964] 30 p refs In FRENCH Presented at the 4th Congr. of the Intern. Council of Aeron. Sci., Paris, 24–28 Aug. 1964
(ONERA-TP-115(1964))

Efforts to obtain precise wind tunnel and flight measurements of the coefficients of heat transfer for 60° delta wings of the type being considered for the supersonic transport aircraft are reported. To facilitate the comparison, flight and wind tunnel experiments have veen carried out on models of the

same scale and using wings of the same type of construction. Tests were conducted at Mach 2 under temperature and pressure conditions simulating an altitude of 8 km, and in flight at Mach 2.15. Among the conclusions presented are the following: (1) Stanton numbers measured in the wind tunnel are systematically less by 10% to 15% than values calculated by the methods of Van Driest or Michel. (2) The bending at the leading edge does not involve any reduction in the kinetic heating for the relative thicknesses and incidences of flight of a supersonic transport aircraft. (3) The analogy factor S = 2 Ch/Cf is preferable to the generally used S = P−2/3. (4) Flight tests gave coefficients of heat transfer systematically lower than those measured in the wind tunnel. M.P.G.

N65-11781# Dynasciences Corp., Fort Washington, Pa.
EFFECTS OF PROPELLER SLIPSTREAM ON V/STOL AIRCRAFT PERFORMANCE AND STABILITY Technical Report, 24 Apr. 1963–24 Mar. 1964
L. Goland, N. Miller, and L. Butler Ft. Eustis, Va., Army Transportation Res. Command, Aug. 1964 121 p refs
(Contract DA-44-177-AMC-48(T))
(DCR-137; TRECOM-TR-64-47; AD-608186)

An analytical investigation is presented of the aerodynamic forces acting on wing–propeller combinations including the effects of propeller slipstreams. The results of the developed theory are then applied to typical two- and four-propeller VTOL and STOL wing configurations. Correlation with existing test data is shown to be satisfactory. Consideration is also given to such associated items as the effects of the slipstream on wing stall, on aircraft takeoff and landing performance, and on aircraft stability and control. Author

N65-11782# Dynasciences Corp., Fort Washington, Pa.
DOWNWASH IMPINGEMENT DESIGN CRITERIA FOR VTOL AIRCRAFT Technical Report, Jul. 1963–Mar. 1964
Ft. Eustis, Va., Army Transportation Res. Command, Aug. 1964 129 p refs
(Contract DA-44-177-AMC-65(T))
(DCR-139; TRECOM-TR-64-48; AD-608185)

The objective of this program was to utilize existing data for the preparation of design charts for VTOL aircraft to aid in the establishment of aircraft designs that will alleviate the adverse operational conditions resulting from downwash impingement on terrain. Specific areas of investigation included particle entrainment and ingestion and their effect on pilot vision, aircraft damage, personnel injury, and aircraft signature. Methods to quantitatively predict operational conditions resulting from downwash impingement of a VTOL aircraft are presented. Author

N65-11812# Bell Helicopter Co., Fort Worth, Tex.
HIGH-PERFORMANCE HELICOPTER PROGRAM, SUMMARY REPORT, PHASE II
J. F. Van Wyckhouse and W. L. Cresap Ft. Eustis, Va., Army Transportation Res. Command, Oct. 1964 *Its* Rept.-533-099-010
(Contract DA-44-177-TC-711)
(TRECOM-TR-64-61; AD-607344)

This report describes and presents the results of a flight research program to investigate high-speed loaded and unloaded rotors. The compound flight research helicopter, instrumentation, and test program are described, and the test results are presented and discussed. Major modifications to the basic high-performance helicopter (HPH) involved the addition of two J69-T-9 engines, a controllable incidence wing, and controls and elevator–horizontal-stabilizer changes. With the addition of the wing, a maximum true airspeed of 154 knots was obtained at a gross weight approximately 20 percent greater than the basic HPH and severe pitch, roll, and rotor speed control problems were encountered. These were eliminated by sweeping the wing aft and coupling the wing incidence with collective control. With the initial jets-only configuration, dynamic stability problems and an increased fuselage drag were encountered due to flow separation between the engine nacelle and fuselage, and engine pylon–horizontal elevator interference. It is shown that the structural loads, vibration characteristics, and stability and control of the vehicle were satisfactory for all conditions tested. It is concluded that higher speed and increased load capability can be achieved by compounding the helicopter. This can be accomplished with good stability and control, with no increase in vibration and structural loads, and without compromising the autorotation safety characteristics of the helicopter. Author

N65-11917# Royal Aeronautical Society, London (Gt. Brit.)
DATA SHEETS: AERODYNAMICS, VOLUME 3
Dec. 1962 108 p refs

This study contains aerodynamic data sheets pertaining to the dynamic, longitudinal, and lateral stability of aircraft. The application of these data in the airplanes' rolling and yawing moments, with their derivatives, is also discussed. G.G.

N65-12082*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
SONIC-BOOM EXPOSURES DURING FAA COMMUNITY-RESPONSE STUDIES OVER A 6-MONTH PERIOD IN THE OKLAHOMA CITY AREA
David A. Hilton, Vera Huckel, Roy Steiner, and Domenic J. Maglieri Washington, NASA, Dec. 1964 80 p refs
(NASA-TN-D-2539) OTS Prices: HC $2.00/MF $0.75

Measurements of sonic-boom ground overpressures have been made over a period of several months and for several flights each day. Data were obtained both inside and outside of buildings at locations on the ground track and at distances from the ground track of about 5 and 10 miles. Statistical analyses have been performed for both the overpressure and the impulse data. The measured sonic-boom signatures were noted to vary widely both in peak amplitude and in wave shape because of atmospheric dynamic effects. The highest overpressure values were associated with waves having short duration peaks, whereas low overpressure values were associated with rounded-off waves resembling sine waves. The variations of the overpressures and impulses may be represented over the significant range by log-normal distributions, the overpressures having a markedly wider range of variations than the impulses. Measurements at lateral distances of 5 or more miles indicated wider ranges of variations than similar measurements on the ground track. Author

N65-12169# Minnesota U., Minneapolis
PRESSURE DISTRIBUTION MEASUREMENTS OF CONVENTIONAL RIBBON PARACHUTES IN SUPERSONIC FLOW
Eugene L. Haak and Ronald J. Niccum Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1964 34 p refs
(Contract AF 33(616)-8310)
(ASD-TDR-63-662; AD-608305)

Conventionally shaped ribbon parachutes do not function satisfactorily as aerodynamic decelerators in supersonic flow. Their unstable behavior is particularly objectionable.

To determine the cause of this structural and dynamic instability, a series of pressure distribution measurements were made on ribbon parachutes at Mach numbers 0.8, 1.08, 1.2, 3.0, and 4.5. The results of measurements and attempts to indicate the effect of suspension lines and forebodies on the pressure distribution of the parachute canopy are presented. Author

N65-12227# Boeing Co., Seattle, Wash. Airplane Div.
HIGH PERFORMANCE GENERAL PURPOSE ATTACK AIRCRAFT STUDY: VTOL OPERATING CONSIDERATIONS
Jul. 1964 78 p refs
(Contract Nonr-4536(00))
(D6-8676; AD-446224)

The following observations are presented: "VTOL Operations"; "Handling Qualities"; "Cockpit Controls and Displays"; and "Carrier and VTOL Site Preparation." G.G.

N65-12334# Aviation Safety Engineering and Research, Phoenix, Ariz.
PERSONNEL RESTRAINT SYSTEM STUDY, CY-2 DeHAVILLAND CARIBOU. CRASH INJURY EVALUATION
Joseph L. Haley, Jr. and James P. Avery Ft. Eustis, Va., Army Transportation Res. Command, Apr. 1964 60 p refs
(Contract DA-44-177-AMC-888(T))
(AvCIR-62-16; TRECOM-TR-64-3; AD-606893)

This report presents detailed suggestions for the improvement of the personnel restraint system in the U.S. Army CV-2 aircraft. The suggestions pertain primarily to strengthening existing restraint system components rather than to a basic change of the system. The modifications presented indicate an increased strength of the crew seats from 20 to 25 g to 35 to 40 g, and of the lap-belt anchorages for the troop seats from 12 to 15 g to 22 to 28 g. These strength increases increases can be achieved with a weight reduction of 1 pound per aircraft and at a cost of approximately $200 per aircraft. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-11040*# Aeronutronic, Newport Beach, Calif. Applied Research Lab.
DEVELOPMENT OF A HIGH TEMPERATURE BATTERY First Quarterly Technical Report
W. J. Subcasky, O. N. Stamires, and A. Parker-Jones 20 Oct. 1964 57 p refs
(Contract NAS3-6002)
(NASA-CR-54208; U-2844) OTS Prices: HC $3.00/MF $0.50

The literature survey indicates that the crystalline, synthetic zeolites are the most suitable solid electrolytes for a battery designed to operate for three days at a temperature of 425° C. The crystalline zeolites are electrolytic conductors with a low resistivity. Rapid and, in some cases, complete ion exchange has been achieved between the zeolites and both monovalent and divalent cations. Calculated and experimentally determined potentials for possible anode and cathode couples, both as pure molten salts and as solutions in molten LiCl-KCl eutectic, are tabulated. Electrochemical characteristics of molten $BiCl_3$, $FeCl_3$, CuCl, $CuCl_2$, AgCl, and $K_2Cr_2O_7$ and of K_2CrO_4 in LiCl-KCl eutectic are presented. Equipment to vacuum hot press zeolite membranes and to measure their resistance as a function of temperature and surrounding atmosphere is described. Preliminary studies on the ion exchange properties and X-ray diffraction patterns of zeolites with Ag^+ and Cu^{++} are discussed. Author

N65-11199# General Motors Corp., Detroit, Mich. Research Labs.
DEVELOPMENT OF BARIUM OXIDE-URANIUM OXIDE-TUNGSTEN EMITTERS FOR USE IN NUCLEAR HEATED THERMIONIC CONVERTERS. PART I Final Report, 1 Jul. 1963–30 Jun. 1964
Fay E. Gifford and Robert F. Hill 1 Jul. 1964 41 p refs
(Contract Nonr-3870(00))
(AD-447212)

This developmental program has been directed toward the fabrication, operation, and testing of unclad nuclear-heated thermionic emitters that can be operated in the 1100° to 1300° C temperature range with an expected current density capability of 1 to 10 A/cm^2. Electron emitters containing various concentrations of BaO and UO_2 dispersed in tungsten have been tested both in the laboratory and in a nuclear reactor. In the laboratory experiments, electron emission studies, emitter life tests, and barium transpiration studies were conducted on twenty different $BaO-UO_2$-W compositions. The temperature of the emitters in these various experiments was maintained by an electric heater that was incorporated into the emitter design. The barium transpiration rate, which includes the rates of barium production, diffusion, migration, and evaporation, was found to be a function of barium content and compositional form. Author

N65-11267# Harshaw Chemical Co., Cleveland, Ohio Solid State Research Lab.
INVESTIGATION OF THIN FILM CADMIUM SULFIDE SOLAR CELLS Third Quarterly Technical Progress Report, 26 May–25 Aug. 1964
J. C. Schaefer, R. J. Humrick, and R. F. Belt Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 9 Aug. 1964 34 p refs
(Contract AF 33(615)-1248)
(AD-605425)

This program is a continuation of the research and development on large area, thin film, flexible, lightweight cadmium sulfide solar cells. Photovoltaic cells and diodes have been prepared by first depositing a thin film of CuCl on CdS. The CuCl was subsequently converted to $Cu_{5.5}S_5$ by means of H_2S. Optical studies on electroplated and chemiplated barriers have served to confirm the presence of Cu_2S alone or mixed with CuS. Thin layers of SiO have been utilized as a water vapor barrier to significantly decrease degradation of cells. Additional theoretical work has been performed on a heterojunction model of the cell operation. Author

N65-11315# Harshaw Chemical Co., Cleveland, Ohio
INVESTIGATION OF THIN FILM CADMIUM SULFIDE SOLAR CELLS Technical Documentary Report, Sep. 1962–Nov. 1963
J. C. Schaefer, R. J. Humrick, E. R. Hill, and R. F. Belt Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Nov. 1963 69 p refs
(Contract AF 33(657)-9975)
(ASD-TDR-63-743; AD-423684)

Research and development of a large area CdS, vacuum evaporated, thin-film, flexible, lightweight, front-wall solar cell were continued in an effort to improve the performance characteristics. Efficiencies have been increased to a maximum of 5.1%. Power-to-weight ratios of 15 W per pound are normal with 30 as a maximum. An upgrading procedure for low efficiency cells has been developed. Test panels have been submitted for a 30-day orbital space-flight evaluation. Electron damage experiments indicate little effect on the CdS solar cells. X-ray techniques have been used to photograph dislocations in single crystal CdS. Current-voltage curves and spectral-response data analyses have resulted in a one-trap model of the CdS photovoltaic cell. Author

N65-11376# General Motors Corp., Anderson, Ind. Delco-Remy Div.
SILVER-ZINC SECONDARY BATTERY INVESTIGATION Technical Documentary Report, Jul. 1962–Aug. 1963
J. J. Lander and J. A. Keralla Wright-Patterson AFB, Ohio, Res. and Technol. Div., 31 Oct. 1963 89 p
(Contract AF 33(657)-8943)
(RTD-TDR-63-4029; AD-422077)

One-percent palladium added to the silver positive plate appreciably increases cycle life, maintains the monovalent charge capacity for 500 to 1000 cycles, and tends to reduce silver migration through separators. Thirty-five hundred cycles were attained by 25 A-h cells at 25% depth of discharge containing 1% palladium-impregnated positive plates. Silver particle sizes studied in the micron range of >1 to 12 do not appreciably affect voltage, capacity, or cycle life of silver plates. Sealed cell operation on the divalent voltage level is impossible, with the techniques studied, due to excessive gassing on charge. Low-current density operation and high alkali concentration (45%) tend to yield maximum cycle-life performance. The use of polyvinyl alcohol as a binder material in the negative active material increases negative plate life. Increasing Hg content of the negative plate active material and increasing KOH concentration both result in marked reduction in rates of hydrogen generation on stand in the temperature range 75° to 125° F. Increasing HgO content results in decreased cycle life. Two batteries containing 1% palladium-coated silver were cycle life tested. One achieved 633 cycles at 25% depth of discharge; the other achieved 268 cycles at 40% depth of discharge. Author

N65-11403*# General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
CHARACTERIZATION OF NICKEL-CADMIUM ELECTRODES Fourth Quarterly Report, 1 Apr.–1 Jul. 1964
[1964] 27 p
(Contract NAS5-3477)
(NASA-CR-59576) OTS Prices: HC $2.00/MF $0.50

The objective is to develop a method of analysis and characterization of the electrodes used in nickel–cadmium sealed cells. It is based primarily on a comparison of detailed polarization measurements of single electrodes before and after periodic operation in selected modes of cyclic testing of cells at three temperature levels 0°, 25°, and 40° C. A correlation of this data should provide a basis for specifying improved cells for space applications as well as for comparing cells from various manufacturers. During this quarter, cell cyclic tests except for the random discharge tests were in progress. An improved apparatus for determining the gassing characteristics of positive electrodes was constructed, and additional data were collected on four positive plates at four charging rates at room temperature. Author

N65-11441*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
RESISTOJET RESEARCH AND DEVELOPMENT—PHASE II First Quarterly Progress Report, 6 Jul.–30 Sep. 1964
Richard R. John and Stewart Bennett 25 Nov. 1964 116 p refs
(Contract NAS3-5908)
(NASA-CR-54155; RAD-SR-64-290) OTS Prices: HC $4.00/MF $0.75

Experimental results are presented on a fast-heatup low-power (5 to 20 W) resistojet suitable for the attitude control and station keeping of a 500-lb synchronous satellite. Propulsion performance measurements obtained with a stainless-steel heater tube indicate thrust levels of the order of 0.70 $\times 10^{-3}$ lb at 200-sec specific impulse with an electrical input power of 12 W and an ammonia flow rate of 3.2×10^{-6} lb/sec. It is anticipated that operation with a tungsten-tube heater element with ammonia as a working fluid will lead to specific impulses close to 300 sec at the 0.10 to 1×10^{3}-lb thrust level, and at energy conversion efficiencies of about 20%. A preliminary weight analysis on an ammonia resistojet (specific impulse ~270 sec) attitude and orbit control system for a 3-year mission of a 500-lb satellite indicates a total system weight of 85 lb compared to nearly 200 lb for a low-thrust (specific impulse ~75 sec) chemical system. Author

N65-11452*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Electromechanical Div.
DEVELOPMENT OF A HELIOTROPIC ORIENTATION DEVICE FOR HIGH CONCENTRATION RATIO SOLAR POWER GENERATION SYSTEMS Final Report, 15 Jan.–10 Aug. 1964
William J. Leovic 16 Oct. 1964 143 p
(Contract NAS1-3588)
(NASA-CR-57020; ER-6219) OTS Prices: HC $4.00/MF $1.00

A program directed towards the design and evaluation of a passive orientation device for use in alleviating the stringent sun-vector alignment requirements associated with lightweight, high-quality, paraboloidal solar concentrators has been completed. The orientation device fabricated and tested during the program is designed to sense the unbalance of solar energy impinging on sensors located adjacent to the focal plane of the concentrator. The device responds to this unbalance by producing corrective torques, thereby relocating the concentrator and reducing the solar orientation error. A variety of mechanisms using bimetallic and vapor pressure sensor–actuator elements were evaluated, and the vapor pressure type was selected. A mercury-filled sensor and bellows-actuator mechanism was constructed and integrated with a calorimeter device that simulates a thermionic generator. Test results have shown that the mount is easily capable of reducing ±5° alinement errors to less than ±5 min when applied in a system consisting of a searchlight quality 5-ft concentrator and a simulated thermionic generator operating at 2000° K. Author

N65-11495*# Duke U., Durham, N.C. Coll. of Engineering
POWER CONDITIONING—INVERSION, CONVERSION, AND REGULATION
Thomas G. Wilson and Edward T. Moore 31 Mar. 1964 23 p refs
(Grant NsG-152)
(NASA-CR-59538) OTS Prices: HC $1.00/MF $0.50

A number of important aspects of power-conditioning technology for spacecraft electrical systems are indicated and briefly discussed. Conclusions reached include the following: (1) The switching element is presently and will continue to be the single most limiting component of inversion and

conversion systems. (2) Almost all of the basic components used in power-conditioning circuits will be hard pressed by some of the environmental requirements that will be encountered in future systems, notably high temperature and large radiation dosages. (3) The specification of 400 cps sinusoidal sources for applications where ac power is required does not take fullest advantage of present inverter capabilities. P.V.E.

N65-11509# Wisconsin U., Madison Engineering Experiment Station

PHOTOVOLTAIC POWER SYSTEMS USING HIGH SOLAR ENERGY FLUXES First Quarterly Progress Report, Mar. 1–May 31, 1964

P. Schoffer, W. Hartman, and W. Beckman [1964] 42 p refs

(Contract DA-28-043-AMC-0005(E))

(Rept.-1; AD-447725)

This report presents experimental results on three kinds of solar cells. Data are presented on the voltage-current characteristics of two kinds of cells between 25° and 95° C and solar fluxes between 100 and 350 langleys per minute. The efficiencies of all three kinds are presented as a function of cell temperature and range from over 7% to less than 4%. Various methods of cooling the cells are discussed. A closed-loop, forced-circulation system using water as the cooling medium has been selected as the most promising. Calculations showing the effect of certain design parameters on the cell temperature and the auxiliary power requirements are presented. Author

N65-11518*# Globe-Union, Inc., Milwaukee, Wis.

A PROGRAM TO DEVELOP A HIGH-ENERGY DENSITY PRIMARY BATTERY WITH A MINIMUM OF 200 WATT HOURS PER POUND OF TOTAL BATTERY WEIGHT First Quarterly Report, Jul.–Sep. 1964

William E. Elliott, Shih-liang Hsu, and Warren L. Towle 16 Oct. 1964 55 p

(Contract NAS3-6015)

(NASA-CR-54187) OTS Prices: HC $3.00/MF $0.50

The behavior of nonaqueous electrolytes was studied, and the solvents acetonitrile and N-nitrosodimethylamine produced solutions with the highest conductances. The best solutes were those possessing alkali metal or quaternary ammonium cations and hexafluorophosphate, hexafluoroarsenate, or hexafluoroantimonate anions. Exploratory tests using mixed solvents, solutes prepared metathetically, diluents to control viscosity, and low melting fused salts all demonstrated the feasibility of the concepts involved. Temperature coefficients for a number of nonaqueous solutions were also determined and are generally less than two percent per degree Centigrade. Preliminary electrochemical tests demonstrated the feasibility of discharging lithium anodes in an ethylene carbonate–propylene carbonate solution. D.E.W.

N65-11560# General Motors Corp., Detroit, Mich. Research Labs.

DEVELOPMENT OF BARIUM OXIDE–URANIUM OXIDE–TUNGSTEN AND BARIUM OXIDE–URANIUM OXIDE–RHENIUM EMITTERS FOR USE IN NUCLEAR HEATED THERMIONIC CONVERTERS Annual Report, 1 Jun. 1962–30 Jun. 1963

Fay E. Gifford and Robert F. Hill 1 Jul. 1963 75 p refs

(Contract Nonr-3870(00))

(AD-409015)

Thermionic energy converters that presently use unclad nuclear fuel emitters operate in a high temperature region (1700° to 2000° C) due to the electron emission characteristics of the emitter. In this temperature region, the life of the emitter is much lower than desired due to evaporation of the emitter material. A possible solution to this problem is to operate the nuclear heated thermionic emitter at a much lower temperature (1100° to 1300° C) where evaporation of the nuclear fuel in the emitter is negligible over long periods of time. This report is concerned with the research and development of nuclear heated emitters that can be operated in the 1100° to 1300° C range with an electron emission capability of 1 to 10 amps/cm^2. The results of this program are summarized in three major sections—material studies, emission studies, and emission microscope studies. Author

N65-11631*# Electric Storage Battery Co., Yardley, Pa.

ALKALINE BATTERY SEPARATOR STUDY Eighth Quarterly Report (Final), Mar. 29–Jun. 28, 1964

E. Weiss 31 Jul. 1964 54 p

(Contract NAS5-2860)

(NASA-CR-59591; ESB-7054.8) OTS Prices: HC $3.00/MF $0.50

The objective was to develop bench tests that would permit screening of separator materials for silver–zinc and silver–cadmium batteries. These tests were applied to a range of membranes. The experience gained was applied to modify available materials and to develop new membranes of potential use in Ag-Zn batteries. Ability to resist silver diffusion and zinc penetration, and to low electrical resistance proved to be the most important parameters. Treatment with some antioxidants or with diisocyanates showed promise as a means of improving the resistance of cellophane against degradation by Ag_2O. An ion exchange membrane formed by polymerizing and cross-linking methacrylic acid in a matrix of microporous polyethylene is another potential separator, with improved oxidation resistance. Sausage casings were found to be more resistant to zinc penetration than any other separator material, but the improvement is marginal; an intensive investigation of this aspect is recommended. Author

N65-11675# Magna Corp., Anaheim, Calif. Research and Development Labs.

BIOCHEMICAL FUEL CELLS Third Quarterly Progress Report, 1 Jan.–31 Mar. 1963

J. M. Brake and W. R. Momyer [1963] 32 p refs

(Contract DA-36-039-SC-80866)

(Rept.-3; AD-408417)

Studies on the electrochemical behavior of two products (ammonia and hydrogen) of potentially useful biochemical reactions are reported. The anodic behavior of hydrogen and ammonia under conditions compatible with biological systems are reported. Various catalysts were studied and the optimum catalyst and conditions for electrooxidation compatible with the biological system selected. Polarization characteristics of the *B. Pasteurii*-urea and *Cl. butyricum*-glucose systems under conditions where the biological phase was physically confined at the electron carrier surface were obtained. Limiting current densities of 3 mA/cm^2 and open circuit potentials of −0.23 V vs SCE were obtained for the *B. pasteurii*-urea system. The performance of the *Cl. butyricum*-glucose electrode system was inhibited. Evidence is presented to indicate that the inhibition is probably due to carbon black adsorbing the hydrogen produced by the *Cl. butyricum*. Author

N65-11697# Naval Ordnance Lab., Corona, Calif. Research Dept.

CHEMOELECTRIC ENERGY CONVERSION FOR NONAQUEOUS RESERVE BATTERY SYSTEMS Quarterly Report, Jul–Sep. 1964

R. E. Panzer et al 15 Nov. 1964 24 p refs
(NAVWEPS-8210; AD-451296)

CONTENTS:

1. NONAQUEOUS SOLVENT ELECTROCHEMISTRY R. E. Panzer p 1–5 refs

2. ELECTROREDUCTION OF AROMATIC NITRO COMPOUNDS IN LIQUID AMMONIA SOLUTIONS W. S. Harris and W. G. French p 6–10 refs

3. AMMONIA CELL EXPLORATORY DEVELOPMENT J. C. Daley, G. E. Mc Williams, and W. C. Spindler p 10–21 refs

N65-11708# General Electric Co., Schenectady, N.Y. Research Lab.
THERMIONIC CONVERTER RESEARCH STUDIES Final Report, Mar. 1961–Oct. 1964
J. M. Houston and H. F. Webster Oct. 1964 141 p refs
(Contract AF 19(604)-8424)
(AFCRL-64-409; AD-607400)

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STUDIES ON A CESIUM THERMIONIC CONVERTER INCORPORATING A THORIUM DISPENSER CATHODE

1. PERFORMANCE CHARACTERISTICS AND EMISSION COOLING MEASUREMENTS TAKEN ON A Cs VAPOR THERMIONIC CONVERTER WITH A THORIUM-TUNGSTEN EMITTER J. M. Houston p 9

2. ION CURRENT IN THE RETARDING-RANGE CESIUM THERMIONIC CONVERTER J. M. Houston p 11–29 refs (See N65-11709 02-03)

3. APPARENT DEPENDENCE OF COLLECTOR WORK FUNCTION ON EMITTER TEMPERATURE J. M. Houston p 31–36 refs (See N65-11710 02-03)

STUDIES OF ELECTRODE MATERIALS

4. THERMIONIC EMISSION OF CLEAN REFRACTORY METALS IN CESIUM VAPOR J. M. Houston p 39–44 refs (See N65-11711 02-03)

5. THERMIONIC EMISSION OF THERMIONIC CONVERTER COLLECTOR MATERIALS IN Cs VAPOR J. M. Houston and P. K. Dederick p 45–81 refs (See N65-11712 02-26)

6. THERMIONIC EMISSION FROM METAL CRYSTALS IN ALKALI METAL VAPORS H. F. Webster and P. L. Read p 83

7. SINGLE-CRYSTAL THERMIONIC CONVERTER STUDIES H. F. Webster p 85

8. UNIFORM WORK FUNCTION SURFACES H. F. Webster p 87–102 refs (See N65-11713 02-26)

9. THE THERMIONIC CONVERTER WITH UNIFORM WORK FUNCTION ELECTRODES H. F. Webster p 103–111 (See N65-11714 02-03)

RESEARCH TECHNIQUES

10. OPTIMUM DESIGN OF CYLINDRICAL ELECTRON BOMBARDMENT HEATERS J. M. Houston, T. A. Howlett, and H. F. Webster p 115

11. PYROMETER CORRECTION DUE TO DIMER ABSORPTION IN Cs VAPOR J. M. Houston and P. K. Dederick p 117 ref

N65-11709# General Electric Co., Schenectady, N.Y. Research Lab.
ION CURRENT IN THE RETARDING-RANGE CESIUM THERMIONIC CONVERTER
J. M. Houston *In its* Thermionic Converter Res. Studies Oct. 1964 p 11–29 refs (See N65-11708 02-03)

Ion current measurements are described that were made by operating the collector of a Cs thermionic converter (with an ion-rich emitter sheath) several volts negative with respect to emitter. A theory for this ion current is developed that involves a mobility-limited ion flow, the electron gas in the plasma being in equilibrium with that in the emitter. Theory and experiment agree well if an ion mobility of 0.12 cm^2/Vsec (at a Cs density of 2.69 × 10^{19} atoms/cm^3) is assumed, the average interelectrode gas temperature being in the range 1000° to 1300° K. This mobility value is a little larger than those given by Chanin and Steen, or by Sheldon for Cs^+ ions. Author

N65-11710# General Electric Co., Schenectady, N.Y. Research Lab.
APPARENT DEPENDENCE OF COLLECTOR WORK FUNCTION ON EMITTER TEMPERATURE
J. M. Houston *In its* Thermionic Converter Res. Studies Oct. 1964 p 31–36 refs (See N65-11708 02-03)

This report describes measurements that apparently indicate that the collector work function depends somewhat on the emitter temperature. The tube used was No. 6A, which is described in the preceding report. The collector temperature, T_c, was held only 50° above the Cs reservoir temperature, T_r. At this temperature (which was well below the collector temperature yielding minimum ϕ_c) the thermionic emission from the collector was negligible. Ohmic leakage currents were also negligible, because the metal–ceramic seal incorporated an extra guard ring electrode. Author

N65-11711# General Electric Co., Schenectady, N.Y. Research Lab.
THERMIONIC EMISSION OF CLEAN REFRACTORY METALS IN CESIUM VAPOR
J. M. Houston *In its* Thermionic Converter Res. Studies Oct. 1964 p 39–44 refs (See N65-11708 02-03)

The thermionic emission of six clean polycrystalline refractory metals in Cs vapor has been measured using the plasma anode technique. In this technique a small loop of wire is immersed in the plasma of a conventional Cs-vapor gas discharge tube and run negative with respect to plasma potential. The small ion current arriving at the loop allows a much larger electron current to leave the loop without encountering electron space charge. A pure insulator is used to shield all except the tip of the emitting loop so as to expose only a small area (e.g., 0.05 cm^2) having a uniform temperature. This technique has the advantage that measurements can be made at much higher Cs pressure than when using the Taylor–Langmuir technique, and thus can avoid the enormous extrapolation involved in applying these data to thermionic converters. The disadvantages of this technique are as follows: (1) Emitter temperatures are more difficult to ascertain accurately, especially at temperatures below the pyrometry range. (2) There is a possibility of the alumina insulator contaminating the emitter. (3) It is difficult to make zero-field measurements; i.e., some electric field is present during the measurement. Author

N65-11714# General Electric Co., Schenectady, N.Y. Research Lab.
THE THERMIONIC CONVERTER WITH UNIFORM WORK FUNCTION ELECTRODES
H. F. Webster *In its* Thermionic Converter Res. Studies Oct. 1964 p 103–111 refs (See N65-11708 02-03)

The thermionic converter made with uniform work-function electrodes may perform better than polycrystalline devices, because the operating temperature can be optimized for the particular work function, a wider range of work-function values is available with the addition of the crystal-face variable, and electron and ion mixing for space-charge neutralized flow can be much better. It is shown that such a converter operating with low emitter temperatures will still need to use volume ionization for optimum performance; with higher emitter temperatures and with use of selected crystal faces for emitter surfaces, it can operate with minimized scattering loss. The work function of an emitter when it is emitting a neutral emission of ions and electrons is a figure of merit for cesiated emitters in converters, using surface ionization as the sole ion source. When this number is high, the pressure of cesium required to yield a certain emission is low, and transport effects in the plasma are small. D.S.G.

N65-11749# Tyco Labs., Inc., Waltham, Mass.
ELECTROCHEMISTRY OF FUEL CELL ELECTRODES Semi-annual Technical Summary Report, Period Through Sep. 30, 1964
A. C. Makrides [1964] 11 p refs
(Contract Nonr-3765(00); ARPA Order 302-62)
(AD-606347)

Work performed to clarify the molecular basis of electrocatalysis, and thereby to provide the necessary scientific framework for the optimization of fuel-cell electrodes, is discussed. Using electrodes of varied chemical composition, an attempt was made to show whether their catalytic properties depend primarily upon the intrinsic chemical activity of the individual surface atoms, or upon the energy states of the crystal as whole. The discussion is presented under the following headings: (1) "Electrocatalysis by Amalgam Electrodes"—hydrogen overvoltage on indium, computer programs, double-layer capacity of indium amalgams, thallium amalgams, work functions, and interfacial tension; and (2) "The Oxidation and Adsorption of Soluble Organic Materials on Smooth Platinum"—adsorption of HCOOH, adsorption of CO, and comparison between CO_{ads} and $HCOOH_{ads}$. P.V.E.

N65-11793# Pratt and Whitney Aircraft, East Hartford, Conn.
LIQUID METAL-HEATED SPACE RADIATOR-MOUNTED THERMIONIC GENERATOR Technical Documentary Report, 1 Jul. 1963–30 Jun. 1964
F. C. Harter Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Oct. 1964 154 p refs
(Contract AF 33(657)-11320)
(PWA-2369; APL-TDR-64-121; AD-608061)

A program to evaluate thermionic generators in a configuration appropriate for liquid-metal heating at temperatures up to 1500° C was conducted. The thermionic generator evaluated was cylindrical and consisted of a nickel collector surrounding a trilayer emitter structure. The trilayer structure consisted of a tantalum–tungsten alloy tube, which could contain the liquid metal, surrounded by a concentric insulating beryllium-oxide tube, and a tungsten–rhenium alloy emitter tube. The generator met or exceeded the performance goals of the program. At an emitter temperature of 1500° C, the power density measured was 50 percent greater than the design objective of 4 W/cm^2, and the measured efficiency matched the goal of 10 percent. The power density of 1.07 W/cm^2 at 1195° C exceeded the performance goal of 1 W/cm^2 at 1200° C. The trilayer emitter assembly maintained its electrical insulating properties, but the thermal resistivity varied from 2.5° to 10° C/Wthermal/cm^2. To attain adequate heat flux through the trilayer assembly, high central tube and heater temperatures were required. These led to test system difficulties that subjected the generator to major thermal cycling from operating to room temperature. Other thermal cycling (from open circuit to power producing conditions) and the major thermal cycling induced fatigue in the ceramic seals that limited the life of the generators. Author

N65-11814# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
INVESTIGATION OF THE HYDROGEN-OXYGEN FUEL CELL II
Walter G. Taschek and Herbert F. Hunger Jul. 1964 26 p refs
(AEL-TR-2491; AD-607544)

This report advances the general knowledge of fuel cells, and provides information concerning high-drain hydrogen and oxygen (air) electrodes for use in acid electrolytes. The information includes the various preparation steps and sequence of steps involved in preparing electrodes with high current carrying ability, the characterization of the carbon carrier material used, and the results of performance and life tests. Theoretical considerations concerning the polarization behavior of oxygen electrodes and the position of the reaction zone within the electrode structure are offered. Author

N65-11881# General Motors Corp., Indianapolis, Ind. Allison Div.
THERMALLY REGENERATIVE FUEL CELLS
Robert E. Henderson *In its* Allison Res. and Eng., Vol. No. 2, Second Quarter 1964 1964 p 15-21 refs (See N65-11879 02-15)

A review of thermally regenerative fuel cells includes definition; classification; theoretical thermodynamic investigations of reversible and nonreversible systems; summary of experimental results, particularly for the potassium–mercury system; and conclusions. Although the thermally regenerative cell has potential for energy conversion, particularly for space power systems, no thermally regenerative system has reached the applications stage because of practical problems. Since liquid-metal systems offer the best possibility for practical applications, the major areas requiring additional research are indicated. M.P.G.

N65-11904*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
SOLAR-CELL PERFORMANCE AT HIGH TEMPERATURES
Jacob D. Broder, Harold K. Kautz, Joseph Mandelkorn, Lawrence Schwartz, and Robert P. Ulman Washington, NASA, Dec. 1964 9 p refs Presented at Fourth Ann. Photovoltaic Specialists' Conf., Cleveland, 2–3 Jun. 1964
(NASA-TN-D-2529) OTS Prices: HC $0.50/MF $0.50

Open-circuit voltage, curve power factor, and maximum power output as functions of temperature were measured for 1-, 10-, 20-, and 80-ohm-cm silicon cells. The results were compared with those for gallium arsenide solar cells and indicated that, for temperatures to 200° C, 1-ohm-cm silicon solar cells performed better than any other commercially available solar cells. One- and ten-ohm-centimeter bombarded silicon solar cells were also measured and compared at high temperatures. In the temperature range to 100° C, the 10-ohm-cm silicon cell was superior to the 1-ohm-cm cell after bombardment. Author

N65-11905*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
A PARAMETRIC EXPLORATION OF AXIAL-FLOW TURBINES FOR RANKINE CYCLE SPACE POWERPLANTS IN THE MEGAWATT RANGE

John L. Klann and Paul T. Kerwin Washington, NASA, Dec. 1964 31 p refs
(NASA-TN-D-2544) OTS Prices: HC $0.75/MF $0.50

A parametric analysis has been conducted to determine the interactions of several design variables in obtaining maximum turbine efficiency. Alkali-metal vapor, axial-flow turbines were investigated within a framework of several generalizing assumptions. Turbine tapering (i.e., changing the ratio of last- to first-stage blade mean-section diameter) was an effective means for attaining maximum overall static efficiency with a minimum number of stages. The turbine taper ratios for maximum efficiency solutions decreased with increasing working fluid molecular weights. At an inlet temperature of 2500° R, these solutions were characterized by 12 stages for sodium with a taper ratio of at least 1.5, 7 stages for potassium with a taper ratio of roughly 1.3, 5 stages for rubidium with a taper ratio of 0.985 (nearly constant mean diameter), and 3 stages for cesium with a taper ratio of 0.95 (nearly constant tip diameter). Author

N65-11968# Thermo Electron Engineering Corp., Waltham, Mass.
EFFECT OF ELECTRODE CONFIGURATION ON THERMIONIC CONVERTER OUTPUT CHARACTERISTICS Third Annual Technical Summary Report, Mar. 11, 1963–Mar. 10, 1964
[1964] 125 p refs
(Contract AF 19(604)-8453)
(TE7-65; AFCRL-64-721; AD-607528)

The work function of a large, planar, polycrystalline rhenium emitter in the presence of cesium vapor was determined through measurements of the lower mode saturation current. The results for the whole temperature range were correlated with the ratio T_E/T_R of the emitter temperature to the cesium reservoir temperature by a single curve with a scatter of less than 0.10 V. The experimental results were extrapolated to cesium pressures up to 30-mm Hg to cover the whole range of operations of a thermionic converter. Also, the work function of a polycrystalline molybdenum collector, in the presence of cesium vapor, was determined experimentally through both emission and collection processes. Based on the data obtained, the performance of the thermionic converter was correlated in terms of the deviation of the actual performance from the "ideal" performance. The ratio J_s/J_s of the apparent saturation current to the true saturation current in the lower mode ion-rich operation was measured and correlated with the product Pd of the cesium pressure, with the spacing, and with the relative ion richness. A detailed description of the test vehicle is given. D.E.W.

N65-12024# North American Aviation, Inc., Los Angeles, Calif. Aeronautical Systems Div.
POWER CONVERSION AND GENERATION STUDY Second Quarterly Progress Report, 15 Jul.–15 Oct. 1963
J. J. Pierro 15 Oct. 1964 117 p
(Contract AF 33(657)-11049)
(NA-63-755-2; AD-423689)

Analyses of three converter concepts, i.e., the motor-generator design, static (tube) converter designs, and static (transistor) converter designs, are presented. Weight-versus-frequency and efficiency-versus-frequency data are given for three frequency levels of the converters. The weight advantage of the static (transistor) converter concept over the other two concepts is shown at each of the three conversion frequencies. The static (transistor) converter is the most efficient of the three concepts, exceeding the design objective of 90%. The effect of cooling-system requirements on total system weight is also discussed for each system concept. D.S.G.

N65-12084*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
ANALYSIS OF A DOUBLE FIN-TUBE FLAT CONDENSER-RADIATOR AND COMPARISON WITH A CENTRAL FIN-TUBE RADIATOR
Henry C. Haller Washington, NASA, Dec. 1964 45 p refs
(NASA-TN-D-2558) OTS Prices: HC $2.00/MF $0.50

An analytical study of a flat condenser–radiator with a double fin-tube geometry (closed sandwich) with variable tube side-wall thickness was performed for a Rankine space-power electric-generating system. The analysis of the double-fin radiator included consideration of tube and header pressure drops, meteoroid protection for the tubes and headers, along with a detailed presentation of the heat-rejection analysis and total weight characteristics. The double fin-tube radiator is compared to a conventional central fin-tube configuration on a heat rejection to weight basis for a four-panel radiator configuration. Both fin and tube geometries are compared on the basis of the same power level, working fluid temperature, tube and header pressure drop, radiator material, and meteoroid protection criteria. A beryllium radiator for a 1-MW system and a columbium alloy radiator for a 500-kW system, both at a radiating temperature of 1700° R, were chosen for the weight and geometry comparisons. Author

N65-12128# Harshaw Chemical Co., Cleveland, Ohio
RESEARCH ON PHOTOVOLTAIC CELLS Interim Technical Documentary Report, 1 May 1963–30 Apr. 1964
Norman E. Heyerdahl, Donald J. Harvey, and Roger F. Bell Wright-Patterson AFB, Ohio, ARL, Oct. 1964 38 p refs
(Contract AF 33(657)-7916)
(ARL-64-142; AD-608468)

This report describes research and development on thin-film photovoltaic cells. The GaAs, ZnSe, and CdTe films were prepared by vacuum coevaporation of the elemental constituents. Measurements of resistivity, absorption edge, X-ray diffraction pattern, and Hall effect are described. Photovoltaic barriers were prepared on CdTe thin films and on ZnSe single crystals by reaction with an aqueous solution containing copper ions. Measurements of the I-V curve and spectral response are given. Preliminary measurements in CdS and ZnSe single crystals by X-ray diffraction topography are discussed. Author

N65-12158# Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION Quarterly Technical Progress Report, 1 Jun.–31 Aug. 1964
W. D. Jackson, G. A. Brown, J. L. Kerrebrock, and E. N. Carabateas 15 Sep. 1964 30 p refs
(Contract AF 33(615)-1083)
(QTPR-4; AD-607784)

The following studies are presented in this progress report: "Liquid-Metal Magnetohydrodynamic Generators"; "Magnetohydrodynamic Channel Flow"; "Electrical Conductivity Measurements"; "Systems with Alkali-Metal Vapor Generators"; "Study of Transport Equations in Cesium Thermionic Converters"; "Studies of Surfaces"; "Electron and Ion Emission from a Tungsten Monocrystal"; "Magnetohydrodynamic Induction Machine of Finite Length"; and "Penetration Coefficient for an Ion in a Partially Mobile Film." G.G.

N65-12207*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
POWER-SUPPLY SYSTEMS AND TEST SOLAR CELLS

John L. Patterson *In its* Micrometeoroid Satellite Explorer XIII (1961 Chi) Nov. 1964 p 79–100 refs (See N65-12203 02-31) OTS Prices: HC $3.50/MF $1.25

Conversion of solar energy with photovoltaic solar cells was decided to be the most practical means of meeting the low-level power requirements throughout the desired 1-year lifetime of the satellite. Rechargeable batteries were necessary to supply all power required during the orbital dark periods, as well as to supply a large part of the power required during interrogations in sunlight. Two separate solar power supplies were installed, one for each telemeter. Each supply was required to furnish 10-mA of standby current and 110-mA during interrogations at 12 V nominal. The power supplies were designed for 1-minute interrogations during each orbit; orbital periods were approximately 100 minutes and orbital dark times varied from 0 to 35 percent of each orbital period. In addition, the satellite was to be spin stabilized at 200 rpm at launch, but was expected to tumble at approximately 20 rpm after several weeks. In addition to the solar cells used for power, five groups of solar cells were mounted on the forward shell to obtain data on the relative effectiveness of protective covers for the cells.
Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-10964# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

THE RADIATION DOSE ACCUMULATED BY BLOOD DIVERTED THROUGH A SHUNT

George Marsaglia Jul. 1964 12 p refs *Its* Mathematical Note No. 357
(DI-82-0362)

Modern techniques have made it possible to divert a portion of the circulating blood through a shunt outside the body, for example, in heart–lung machines, artificial kidneys, and coiled tubes where the blood may be exposed to radiation without danger to body tissues. There is some probability theory connected with such procedures, for the cells of the blood are thoroughly mixed in the body, and hence the number of times a blood cell passes through the shunt is a random variable. This paper discusses the problem in terms of probability theory, finding the exact distribution of the number of times a blood cell has passed through the shunt and, in addition, a normal approximation that makes calculation of accumulated doses a matter of simple arithmetic.
Author

N65-10982# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

AVERAGE DIAMETER OF RED BLOOD CORPUSCLES UNDER THE CHRONIC ACTION ON THE HUMAN ORGANISM OF SMALL DOSES OF IONIZING RADIATION

Ye. D. Gol'dberg 17 Sep. 1963 7 p refs Transl. into ENGLISH from Lab. Delo (Moscow), v. 9, no. 2, 1963 p 9–11 (FTD-TT-63-784/1; AD-422453)

Average diameters and volumes of erythrocytes were determined for blood samples from normal or control subjects and for samples from persons working in environments of 0.02 to 0.04 R per day. It is concluded that the presence of a statistically definite tendency toward the development of macrocytosis in exposed subjects is evidence of stable displacements of erythropoiesis to the side of increase in the specific weight of the macroblastic blood formation. Such a tendency seems to appear in the case of long-term action on the organism of ionizing radiation in doses of the order of 0.02 to 0.04 R per day.
D.E.W.

N65-10989# Joint Publications Research Service, Washington, D.C.

MOTOR REACTIONS UNDER CONDITIONS OF WEIGHTLESSNESS

I. I. Kas'yan, V. I. Kopanev, and Ye. M. Yuganov 30 Nov. 1964 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 5, Sep.–Oct. 1964 p 677–689.
(JPRS-27591; TT-64-51820)

Experiments with human subjects under conditions of weightlessness are discussed. Conclusions include statements that flights under these conditions lead to insignificant changes in certain indicators of human movements, that the genesis of the disorders observed under conditions of weightlessness is apparently caused by a disturbance in the functional systems at work in the analyzers, and that the influence of prolonged weightlessness on the organisms of animals and man is still incompletely understood.
D.E.W.

N65-11021*# National Aeronautics and Space Administration, Washington, D.C.

STRUCTURE AND FUNCTION OF THE VESTIBULAR APPARATUS UNDER CONDITIONS OF AN ALTERED GRAVITATIONAL FIELD [STRUKTURA I FUNKSTIYA VESTIBULYARNOGO APPARATA v USLOVIYAKH IZMENENNOGO GRAVITATSIONNOGO POLYA]

Ya. A. Vinnikow Nov. 1964 18 p refs Presented at the 15th Intern. Astronautical Congr., Warsaw, 7–12 Sep. 1964 (NASA-TT-F-278) OTS Prices: HC $0.50/MF $0.50

It is concluded that the shifts observed in the substructural and cytochemical organization of the ciliated cells and synapses of the utricle during acceleration apparently reflect a state of excitation and transmission of impulses. Results obtained from the study reveal, to some extent, the mechanism of the function of the "organ of gravity" on the cellular and subcellular levels of organization and indicate methods and possibilities of controlling its functioning under conditions of acceleration and space flight. However, the processes of specific stimulation of the utricle, as well as the interdependence of its activity with that of other receptor elements of the vertebrate vestibular system, are still unclear.
D.E.W.

N65-11045*# National Aeronautics and Space Administration, Washington, D.C.

EFFECT ON THE BODY OF PROLONGED EXPOSURE TO CONDITIONS OF ARTIFICIAL ATMOSPHERE [VLIYANIYE NA ORGANIZM DLITEL'NOGO PREBYVANIYA v USLOVIYAKH ISKUSSTVENNOY ATMOSFERY]

A. G. Kuznetsov et al Nov. 1964 8 p Presented at the 15th Intern. Astronautical Congr., Warsaw, 7–12 Sep. 1964 (NASA-TT-F-9178) OTS Prices: HC $3.00/MF $0.75

The essential medical–biological problems of creating a gas-medium environment for human beings which permits the prolonged exposure in a sealed chamber of limited dimensions, are discussed. The dynamics of gas metabolism, cardiovascular-system functions, and peripheral blood composition were studied in two subjects who were exposed for many days to conditions of partial oxygen pressure of 160- to 170-mm Hg.

The subjects developed symptoms of general asthenia, lowered oxygen requirements, deterioration of the isometric tolerance and isotonic strength indices in individual muscle groups, lowered resistance to acceleration, the onset of irritability and fatigue, and deterioration of the ability to perform set tasks at the end of the experiment. G.G.

N65-11057*# National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography Apr.–Jun. 1964
Aug. 1964 186 p
(NASA-SP-7011(01)) OTS Prices: HC $1.00/MF $1.25

An annotated bibliography is given of unclassified reports and journal articles that were introduced into the NASA information system during this period. The subject matter covers biological, physiological, psychological, and environmental effects to which man is subjected during the following simulated or actual flight in the atmosphere or in space. These areas were announced previously in separate publications by the Library of Congress, the American Institute of Aeronautics and Astronautics, and NASA. The references are indexed by subject, corporate source, and personal author. R.L.K.

N65-11098# Chicago U., Ill.
USAF RADIATION LABORATORY QUARTERLY PROGRESS REPORT NO. 53
Kenneth P. Du Bois 15 Oct. 1964 142 p refs
(Contract AF 41(609)-1693)
(AD-607952)

CONTENTS:

THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES

1. INFLUENCE OF X-RADIATION AND VARIOUS CHEMICAL AGENTS ON THE DEVELOPMENT OF A THIOPHOSPHATE-OXIDIZING ENZYME SYSTEM IN THE LIVERS OF MALE RATS Bernard E. Hietbrink and Marjorie Keshmiri p 1–12 refs

2. INFLUENCE OF X-RADIATION AND CASTRATION ON STEROID-INDUCED INCREASES IN THE ACTIVITY OF A DETOXIFICATION ENZYME IN THE LIVER OF RATS Kenneth P. Du Bois and Florence Kinoshita p 13–20 refs

3. DEVELOPMENT AND APPLICATION OF A QUANTITATIVE METHOD FOR MEASURING THE INHIBITORY EFFECTS OF X-RAY ON SYNTHESIS OF MICROSOMAL ENZYMES Robert A. Neal, Florence Kinoshita, and Kenneth P. Du Bois p 21–35 refs

PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS

1. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE V. J. Plzak, M. Root, and J. Doull p 36–64 refs

2. DOSE-MORTALITY RELATIONSHIPS FOR SEVERAL RADIOPROTECTIVE AGENTS J. Doull and V. Plzak p 65–97 refs

3. STUDIES ON THE TOXICITY AND MECHANISM OF ACTION OF MERCAPTOETHYLAMINE (MEA) Kei-Ming Yam, Bernard E. Hietbrink, and Kenneth P. Du Bois p 98–107 refs

4. FURTHER STUDIES ON THE RADIOPROTECTIVE ACTION OF SODIUM NITRITE IN MICE A. T. Hasegawa and H. D. Landahl p 108–115 refs

THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS

1. SUMMARY OF THE CHRONIC GAMMA AND LOW LEVEL FAST NEUTRON IRRADIATION PROGRAM A. Sandberg and J. Doull p 116–131 refs

2. HISTOLOGICAL FINDINGS IN THE TISSUES OF MICE SERIALLY SACRIFICED AFTER FEEDING A DIET CONTAINING PARA-AMINOPROPIOPHENONE D. Vesselinovitch, A. Sandberg, and J. Doull p 132–139 refs

N65-11100# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EFFECT OF IONIZING RADIATION ON THE LEVEL OF HISTAMINE IN THE TISSUES AND ITS SIGNIFICANCE IN EARLY RADIATION DAMAGE TO THE HISTOHEMATIC BARRIERS
Ye. I. Krichevskaya and G. V. Kapitonova 15 Oct. 1964 17 p refs Transl. into ENGLISH from Gisto-Gematicheskiye Bar'ery, Trudy Soveshchaniya (USSR), no. 48, 1961 p 48–56
(FTD-TT-64-644/1; AD-607563)

Histamine and its role in the breakdown of the capillary penetrability in radiation-induced pathological conditions of laboratory animals were studied. After a single total radiation of rats with a lethal dose of X-rays, a marked increase in the penetrability of the different histohematic barriers occurred. It was found that the histaminopexic capacity of the blood and the tissues is regulated by the hypophyseal-adrenal system, and changes in the level of histamine by irradiation are not the direct results of the direct action of the X-rays on the tissues. G.G.

N65-11157# Tufts U., Medford, Mass. Neuropsychology Lab.
THE EFFECTS OF DISPLACED EARS ON AUDITORY LOCALIZATION
Sanford J. Freedman and Kenneth Stampfer Aug. 1964 27 p refs
(Contract AF 49(638)-1282; Grant AF-AFOSR-53-63)
(AFOSR-64-0938; AD-604569)

This experiment was an auditory rearrangement. Subjects' judgments of auditory direction were displaced laterally by means of a high-fidelity pseudophone that effectively rotated the interaural axis through a 20° horizontal angle. After exposure sessions that consisted of walking repeatedly toward a fixed sound source for 20 minutes, two of the four experimental subjects demonstrated significant shifts averaging 6° in their judgments of auditory direction. The shifts partially compensated for the error of localization produced by the pseudophone. The shifts in localization are discussed in terms of the nature of the exposure situation and the factors that are likely to be responsible for compensation. Author

N65-11232# Joint Publications Research Service, Washington, D.C.
MEASUREMENT AND COMPUTATION OF ABSORBED DOSES IN EXTERNAL AND INTERNAL IRRADIATION
A. N. Krongauz et al 25 Nov. 1964 48 p Transl. into ENGLISH of selections from the book "Izmereniye i Raschet Pogloshchennykh Doz Pri Vneshnem i Vnutrennem Obluchenii" Moscow, 1963 p 3, 4–34
(JPRS-27527; TT-64-51776) OTS: $2.00

Methods of measuring doses of roentgen and gamma radiation used in practical radiotherapy are presented. Formulas and tables are given for computing absorbed and integral doses in the use of radioactive isotopes of gold, sodium, iodine, and phosphorus for therapeutic and diagnostic aims. D.E.W.

N65-11249# Joint Publications Research Service, Washington, D.C.
ANTIRADIATION PROPERTIES OF ARYLAMIDES AND ARYLHYDRAZIDES OF THIOCARBOXYLIC ACIDS
A. A. Gorodetskiy, P. S. Pel'kis, E. Z. Ryabova, and R. G. Dubenko 25 Nov. 1964 15 p Transl. into ENGLISH of excerpts from the book "Protivoluchevyye Svoystva Arilamidov i Arilgidrazidov Tiokarbonovykh Kislot" Kiev, "Naukova Dumka" Publishing House, 1964
(JPRS-27544; TT-64-51793) OTS: $1.00

Presented are the results of attempts to find new antiradiation compounds in several substituted arylamides, particularly in several arylhydrazides of thiocarboxylic acids. It is concluded that the most effective preparations for prophylaxis and treatment of acute radiation sickness were those exhibiting solubility in water or in aqueous solutions of weak alkalinity. P.V.E.

N65-11250# Human Factors Research, Inc., Los Angeles, Calif.
ADRENALIN, NORADRENALIN AND PERFORMANCE IN A VISUAL VIGILANCE TASK
J. O'Hanlon, Jr. Aug. 1964 35 p refs
(Contract Nonr-4120(00))
(TR-750-5; AD-606136)

An experiment was undertaken to determine the relationship between signal detection performance and plasma concentrations of adrenalin and noradrenalin in adult male observers undertaking a visual vigilance task. Signal difficulty level was equated for each observer in a preliminary experiment, and each individual was then classified as either a decrementing or nondecrementing observer on the basis of his performance on a conventional visual vigilance task. In the subsequent experiment, six decrementing and three nondecrementing observers undertook a conventional visual vigilance task. Seven other decrementing observers served as controls and viewed movies under otherwise identical conditions. Blood samples were drawn from the observers periodically during the vigilance task, and these were analyzed fluorometrically for adrenalin and noradrenalin. It was concluded that the level of circulating adrenalin declines in decrementing observers during a conventional vigilance task in a manner positively related to their performance on the task. Author

N65-11264# Joint Publications Research Service, Washington, D.C.
ANABIOTIC-FLIGHT INTO OUTER SPACE
V. Petrov and P. Yurevich 25 Nov. 1964 8 p Transl. into ENGLISH from Ekon. Gaz. (Moscow), no. 43, 1964 p 4
(JPRS-27540; TT-64-51789) OTS: $1.00

A number of examples are presented of the cessation of life processes with the later resumption of them as the organism revives. Lizards, fish, crawfish, worms, algae, and low-order plants and animals are specifically mentioned. A brief speculation about the possible application of this process to the problems of extended space flights is included. D.E.W.

N65-11277# Clark (David) Co., Inc., Worcester, Mass.
RESEARCH FOR A HEAD ENCLOSURE FOR AEROSPACE ENVIRONMENTS, 1 MAY 1961–3 AUGUST 1962
Edward J. Bedard Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs., Oct. 1963 23 p
(Contract AF 33(616)-8255)
(AMRL-Memo-M-57; AD-423943)

A comprehensive study was made of possible design and fabrication approaches for a lightweight head enclosure for aerospace environments. The prototype dome was designed and developed following careful evaluation of the requirements. The transparent hemispherical dome is hinged in the back and is attached to the standard A/P 22S-2 full pressure suit by aluminum locking rings. The convoluted neck joint restraint material is link-net of Dacron. The dome is supported by braces resting on the shoulders. An antibuffeting helmet of lightweight cotton twill houses the energy absorbing pads of Ensolite, the communication system, and Straightaway Ear Protectors. Author

N65-11305*# National Aeronautics and Space Administration, Washington, D.C.
MODIFICATIONS OF THE OCULAR REFRACTION OF PILOTS AT GREAT ALTITUDES [LES MODIFICATIONS DE LA REFRACTION OCULAIRE CHEZ LES PILOTES DES GRANDES ALTITUDES]
M. Popesco, M. Stefan, and N. Cinca Oct. 1964 21 p refs Transl. into ENGLISH of a paper presented at the 15th Intern. Astronautical Cong., Warsaw, 7–12 Sep. 1964
(NASA-TT-F-9153) OTS Prices: HC $1.00/MF $0.50

The effect of high altitudes on the ocular refraction of pilots was studied in altitude chambers by means of proxiometers. Transient myopia of a degree proportional to the altitude is produced by a spasm of the ciliary muscle. Astigmatism, myopia, and other refraction anomalies are intensified at great altitudes, leading to pilot fatigue. Persons with slight hypermetropia (+1, +2 diopt.) are less affected. Author

N65-11306*# National Aeronautics and Space Administration, Washington, D.C.
BIOLOGY AND COSMONAUTICS [BIOLOGIYA I KOSMONAVTIKA]
N. M. Sisakyan Nov. 1964 10 p ref Transl. into ENGLISH of a paper presented at the 15th Intern. Astronautical Cong., Warsaw, 7–12 Sep. 1964
(NASA-TT-F-9155) OTS Prices: HC $1.00/MF $0.50

This paper is an introductory speech given at a meeting on biosstronautics and space medicine. A general outline is given of the papers presented; important points of further research are also given, with main emphasis on physiological and psychological effects on the human organism of weightlessness, radiation damage, accumulation of anthropotoxins, etc. Author

N65-11325# Technische Hochschule München (W. Germany) Inst. für Angewandte Botanik
EXPERIMENTS ON THE EFFECTS OF COMBINED WAVELENGTHS ON PHOTOSYNTHESIS Final Technical Report
O. Kandler 1 May 1964 16 p refs
(Grant AF-EOAR-63-10)
(AFOSR-64-1650; AD-606077)

Two apparatus were constructed, of which each allows the projection of two monochromatic beams of a high light intensity on the same area of an algae suspension. One device is based on monochromators that are equipped with gratings; the other consists of projectors with interference filters. A suitable cuvette was constructed to expose an algae suspension to the beams, while they are supplied with an air-CO_2 mixture at a constant rate of flow and kept at constant temperature. Photosynthesis is measured by the increase of radioactivity that is taken up from $C^{14}O_2$. Experiments to elucidate the optimal conditions for photosynthesis under our special arrangements are described. Preliminary experiments with combined wavelengths showed the following results. If blue light (454μ) is added to red light (658μ), there is a decrease

in photosynthesis of about 20% below the value obtained by the addition of photosynthesis with the single light beams. If far red light (711μ) is added to red light (658μ) a remarkable increase of 20% to 80% is observed. Author

N65-11396*# Naval School of Aviation Medicine, Pensacola, Fla.
INFLUENCE OF LABYRINTH ORIENTATION RELATIVE TO GRAVITY ON RESPONSES ELICITED BY STIMULATION OF THE HORIZONTAL SEMICIRCULAR CANALS
Manning J. Correia and Fred E. Guedry, Jr. 2 Sep. 1964 13 p refs
(NASA Order R-93)
(NASA-CR-59548; Rept.-100) OTS Prices: HC $1.00/MF $0.50

Differences in nystagmus output with different stopping positions were not entirely consistent with predictions based on the assumption that cupula deflection was influenced by gravity. A more plausible explanation, modulation of canal-initiated responses by otolith activity, was presented. A high incidence of motion sickness was encountered while rotating subjects about the earth's horizontal axis, and it was apparently controlled by the mental task assigned to the subject. Author

N65-11407*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aviation Medical Center
THE EFFECT OF CHANGING THE RESULTANT LINEAR ACCELERATION RELATIVE TO THE SUBJECT ON NYSTAGMUS GENERATED BY ANGULAR ACCELERATION
Martin P. Lansberg, Fred E. Guedry, Jr., and Ashton Graybiel 1 Sep. 1964 42 p refs *Its* Rept.-99
(NASA Order R-93)
(NASA-CR-59565) OTS Prices: HC $2.00/MF $0.50

The effect of centripetal acceleration on nystagmus was studied by placing men at radii of 17 and 20 ft in various orientations relative to the center of rotation. Angular accelerations and decelerations were approximately $10°/sec^2$. In some of these different positions, the planes of the semicircular canals remained unchanged relative to the plane of rotation, but the orientation of the resultant force relative to the otolith system was changed. In several such situations the magnitude, plane, and direction of nystagmus were changed by centripetal accelerations between 1 and 2 g-units. Results are discussed in terms of otolith modulation of sensory input from the semicircular canals. Author

N65-11421# School of Aerospace Medicine, Brooks AFB, Tex.
INCREASE OF ARTERIAL OXYGEN TENSION AT ALTITUDE BY CARBONIC ANHYDRASE INHIBITION
Stephen M. Cain and James E. Dunn, II Sep. 1964 11 p refs
(SAM-TDR-64-55; AD-451065)

Unanesthetized dogs were injected intravenously with 10 mg/kg per 12 hours of the carbonic anhydrase inhibitor, acetazolamide, before exposure to a simulated altitude of 21 000 feet (P_B = 335 mm Hg). Arterial blood samples were drawn frequently from a Teflon T-cannula surgically placed in a carotid artery 1 or 2 days before the experiment. Arterial Po_2, Pco_2, pH, and lactic and pyruvic acid concentrations were measured. In comparison with untreated dogs, arterial Po_2 at altitude was 9-mm Hg higher, on the average, in treated animals. No physiologically significant accumulation of excess lactate was found. The conclusion was made that carbonic anhydrase inhibition did offer measurable protection, with respect to arterial Po_2, against altitude hypoxia and that this protection was achieved at much smaller doses of drug than had been used by other investigators. Author

N65-11422# School of Aerospace Medicine, Brooks AFB, Tex.
PORTER-SILBER CHROMOGEN INTERFERENCE IN THE MEASUREMENT OF BODY FLUID STEROID RESPONSES TO TOTAL FASTING
John R. Prigmore, Ira L. Shannon, Steven C. Beering, and Frank R. Lecoco Sep. 1964 7 p refs
(SAM-TDR-64-58; AD-450962)

Corticosteroid measurements were carried out on three obese male patients during a 12-day period of total starvation. Porter–Silber chromogens in serum and parotid fluid increased to levels indicative of either grossly altered metabolic activity of the steroid hormones or nonsteroidal Porter–Silber chromogen interference. Evidence is presented supporting the inference of chromogenic interference. Author

N65-11451*# National Aeronautics and Space Administration, Washington, D.C.
PSYCHOPHYSIOLOGICAL EFFICIENCY OF THE MACACUS MONKEY AFTER CORTEX ABLATION [PSYCHOPHYSIOLOGISCHE LEISTUNGSFAHIGKEIT DES MACACUS AFFEN NACH CORTEXAUSSCHALTUNGEN]
K. Bättig and H. E. Rosvold Nov. 1964 81 p refs Transl. into ENGLISH from Ergeb. Physiol. Biol. Chem. Exp. Pharmakol. (Berlin), v. 52, 1963 p 157–204
(NASA-TT-F-9178) OTS Prices: HC $3.00/MF $0.75

A general survey is given over the effect of ablation of the secondary cortex in *Macacus* monkeys on their performance in various learning tests. For the secondary or association cortex of the monkeys there exists a distinct subdivision into function-specific areas. Total extirpation of the frontal secondary cortex results in an irreparable loss of the ability for delayed reaction. Frontal-lobe ablation led to the inability of sensory discrimination, typical hyperactivity, and disturbance of the normal emotional behavior. Application of these findings to human pathology is still impossible, because of the lack of similar tests on human subjects. Author

N65-11459# Joint Publications Research Service, Washington, D.C.
TRANSLATIONS FROM GIGIYENA I SANITARIYA (HYGIENE AND SANITATION), NO. 8, 1964
3 Nov. 1964 86 p refs Transl. into ENGLISH from Gigiyena i Sanit. (Moscow), v. 29, no. 8, Aug. 1964
(JPRS-27200; TT-64-51455) OTS: $3.00

CONTENTS:

1. CHEMICAL INDUSTRY AND LABOR HYGIENE Z. I. Izrael'son p 1–4
2. OVERALL IMMUNOBIOLOGICAL REACTIVITY OF THE ORGANISM AND MORBIDITY RATE AMONG CHEMICAL WORKERS M. M. Tarnopolskaya, V. M. Makotchenko, S. M. Bagrova, and V. D. Rozenberg p 5–15 refs
3. COMPARATIVE ASSESSMENT OF THE EFFECT OF CHROMIUM CARBIDE AND BORIDE DUST ON THE ORGANISM T. A. Roshchina p 16–21 refs (See N65-11460 02-04)
4. Q FEVER AT SOME PLANTS IN THE UKRAINIAN SSR V. A. Mukhopad p 22–29 refs
5. MICRO EXPRESS METHOD OF ENZYMETIC DETECTION OF RESIDUAL AMOUNTS OF PHOSPHORORGANIC INSECTICIDES A. A. Pokrovskiy and L. G. Ponomareva p 30–42 refs

6. SANITARY EPIDEMIOLOGICAL SERVICE SUPERVISION OVER CONSTRUCTION PROJECTS V. I. Petrov p 43–46 refs

7. HYGIENIC SIGNIFICANCE OF STRONTIUM IN DRINKING WATER V. A. Krizhnikov and N. Ya. Novikova p 47–53 refs

8. THE ROLE OF MANGANESE IN THE ETIOLOGY OF PNEUMONIA G. Sh. Gabunia p 54–59 refs

9. THE EFFECT OF AERO-IONIZATION OF THE ANIMAL'S ORGANISM IN CO INTOXICATION I. I. Datsenko p 60–62 ref

10. CONFERENCE ON THE PROBLEM OF AEROIONIZATION IN HYGIENE A. M. Skorobogatova p 63–69

11. STATUTE REGULATING THE ACTIVITIES OF THE STATE SANITARY INSPECTION IN THE USSR p 70–78

N65-11460# Joint Publications Research Service, Washington, D.C.

COMPARATIVE ASSESSMENT OF THE EFFECT OF CHROMIUM CARBIDE AND BORIDE DUST ON THE ORGANISM

T. A. Roshchina *In its* Transl. from Gigiyena i Sanit. (Hyg. and Sanit.), No. 8, 1964 p 16–21 refs (See N65-11459 02-04) OTS: $3.00

Four series of tests on 60 white rats were conducted to determine the relative effect of chromium boride and carbide on the body. The test program was instituted to ascertain the applicability of the toxicological characteristics of other chromium compounds to the carbide and the boride, which are released as aerosol-type dusts in factories. It is concluded that chromium carbide dust and chromium boride dust possess a toxic effect that is expressed in the development of pathological changes in lung tissue, that the dust of the boride is more toxic than the dust of the carbide, and that the maximum allowable concentration of chromium boride and carbide dust can be higher than the concentration presently accepted in sanitation norms for chromic anhydride. D.E.W.

N65-11516# Joint Publications Research Service, Washington, D.C.

STUDIES IN ELECTROENCEPHALOGRAPHY

3 Dec. 1964 27 p refs Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 14, no. 5, Sep.–Oct. 1964 p 745–754, 755–762
(JPRS-27677; TT-64-51862) OTS: $2.00

CONTENTS:

1. ON POSSIBILITIES OF EMPLOYING THE CORRELATION ANALYSIS OF THE ELECTROENCEPHALOGRAM (EEG) OF MAN O. M. Grindel', G. N. Boldyreva, Ye. N. Burashnikov, and V. M. Andreyevskiy p 1–13 refs

2. CHANGES IN THE EEG AND CUTANEOUS GALVANIC REACTION DURING THE PROCESS OF FORMATION OF A TEMPORARY CONNECTION BETWEEN MOTOR AND VISUAL ANALYZERS IN MAN V. M. Vasil'yeva p 14–24 refs

N65-11581# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CHANGES OF PULMONARY BLOOD VESSELS IN CHRONIC RADIATION SICKNESS

I. S. Amosov 10 Mar. 1964 14 p refs Transl. into ENGLISH from Med. Radio. (Moscow), v. 7, no. 4, 1962 p 57–64
(FTD-MT-63-223; AD-605906)

The mechanism of the pathogenesis in radiation pneumonia was studied in rabbits by angiocardiography of the pulmonary blood circulation, under physiological conditions and also in chronic radiation sickness. The animals received 25 R daily, for a period of 2 to 3 months, and records were made of their weight, temperature, and respiration rate. The peripheral blood was analyzed, and survey X-rays were performed on the lungs and abdominal cavities. It was found that functional and anatomical changes developed concurrent to the stages of progress in the chronic radiation disease, resulting in an increase of contractions of the pulmonary arteries, depletion of the lung vessel network of small arteries, and a general deformed fibrous pulmonary pattern. G.G.

N65-11585# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

COORDINATION OF VOLUNTARY MOVEMENTS OF A HUMAN FROM THE STANDPOINT OF GENERAL REGULARITIES OF CONTROL AND CONTROL SYSTEMS

L. V. Chkhaidze 6 Feb. 1964 55 p refs Transl. into ENGLISH from Probl. Kibernetiki (Moscow), no. 8, 1962 p 309–336
(FTD-MT-63-265; AD-602585)

The basic problems confronting the central nervous system in the control of voluntary movements are discussed. The following topics were studied: "Concept of External and Internal Forces"; "Concept of Field of Force"; "Concept of the Connection Between Muscular Effort and the Resulting Movement"; "Concept of Mode of Work of Muscles"; "Concept of Dynamic Stability of Movement"; "General Diagram of Control of Voluntary Movements in a Human"; "Certain Data on Activity of Master and Programing Mechanism"; and "Concerning the Question of Activity of the Collating Mechanism." G.G.

N65-11618# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

VESTIBULAR REACTIVITY DURING THE CUMULATIVE ACTION OF SLOW CENTRIPETAL ACCELERATIONS

A. E. Kurashvili 24 Jan. 1964 16 p refs Transl. into ENGLISH from Zh. Ushnykh, Nosovykh i Gorlovnykh Bolezney (Kharkov), no. 1, Jan.–Feb. 1962 p 49–55
(FTD-MT-63-179; AD-602599)

The regular changes of physiological reactions under cumulation of slow centripetal accelerations were studied on dogs. The pulse fluctuations and respiration rates were registered by oscillography during the slow acceleration in a centrifuge of 2-m radius. A number of vegetative disorders were observed and found to be similar to the symptoms of seasickness. The degree of these reactions was dependent on the magnitude of the acceleration force. The exclusion of the functions of the vestibular apparatus by delabyrinthation led to the intensification of motor reactions, and to a disturbance of the cortical regulation of the reflex activity of the compensor mechanism. G.G.

N65-11665# Naval Radiological Defense Lab., San Francisco, Calif.

ABSCOPAL EFFECTS OF WHOLE-BODY X IRRADIATION ON COMPENSATORY HYPERTROPHY OF THE RAT KIDNEY

L. W. Wachtel and L. J. Cole 18 Sep. 1964 29 p refs
(USNRDL-TR-783; AD-450729)

The weight and DNA content of normal growing (i.e., intact), and hypertrophying (i.e., following uninephrectomy) rat kidneys were obtained from several hundred Sprague–Dawley white rats. The effect of whole-body X-irradiation with 500 rad and local irradiation to the kidney with 1000

rad, was then determined by following the rate and degree of hypertrophy and the DNA content of the kidney. Food restriction in nonirradiated 4-week-old rats, resulting in body weight growth retardation, elicited a marked reduction in kidney weight and in DNA content of the hypertrophying kidney 21 days after uninephrectomy. It is concluded that the reduction in kidney hypertrophy following whole-body X-irradiation with 500 rad is due in some measure to an abscopal or indirect effect, secondary to decreased body weight. Author

N65-11666# Naval Radiological Defense Lab., San Francisco, Calif.
ACCUMULATION OF LETHAL IRRADIATION DOSES BY FRACTIONATED EXPOSURE TO X-RAYS
J. S. Krebs and R. W. Brauer 22 Sep. 1964 23 p refs
(USNRDL-TR-784; AD-451037)

The LD_{50} of mice for exposure to daily fractionated irradiation has been measured for fractionation periods of from 5 to 60 days. The amount of recovery occurring during the fractionation was found to depend largely on the number of dose fractions, rather than on the size of fractions or the total time duration. The amount of recovery did not agree with the model involving exponential decay of injury with time after exposure. The results that the biological basis for the recovery is the prompt repair of sublethal injury to vital cells of the mouse during the intervals between exposures to radiation. The existence of similar recovery patterns in previous studies of dose fractionation is pointed out. The relationship of the present pattern of radiation exposure to other patterns for chronic radiation exposure is discussed briefly. Author

N65-11758# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AVIATION PSYCHOLOGY
K. K. Platonov 14 Aug. 1964 362 p refs Transl. into ENGLISH of the book "Psikhologiya Letnogo Truda" Moscow, Voyennoye Izd. Min. Oborony Soyuza SSR, 1960 p 1–351
(FTD-MT-64-177; AD-607906)

This book deals with the objects, methods, and history of aviation psychology; characteristics of mental processes in the pilot's work—problems of attention, thought, memory, emotions, and the psychomotor system; psychological analysis of flying—psychological characteristics of practice flight, flying by instruments, and high altitude, speed, and space flights; special problems of aviation psychology—psychological rationalization of flight training, the regime of flying and rest, aviation engineering; and psychological research in the practice of aviation medicine, medical-aviation expertise. Author

N65-11760# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ADRENALIN-LIKE SUBSTANCES AND BIOLOGICAL ACTIVITY OF THE BLOOD IN CERTAIN FORMS OF NERVOUS PATHOLOGY
G. N. Kassil, E. A. Matlina, and R. A. Sokolinskaya 6 Oct. 1964 19 p refs Transl. into ENGLISH from Probl. Endokrinol. i Gormonoterap. (Moscow), v. 5, no. 1, 1959 p 70–79
(FTD-TT-63-1170/1+2; AD-607542)

The status of the sympathetic and parasympathetic branches of the vegetative nervous system in some forms of nervous pathology was investigated, and the quantitative dependence between the level of adrenalinlike substances and the biological activity of the blood was observed. A high level of adrenalinlike substances and also of the sympathetic activity of the blood was noted in cases of diseases accompanied with a painful syndrome, in certain forms of diencephalic pathology, and in Addison's disease. A low level of adrenalinlike substances in the blood was observed in myasthenia, and a subsequent improvement in the patient's health was found to be connected not only with changes in the acetylcholine exchange but also with the increase of adrenalinlike substances and the sympathetic blood activity. G.G.

N65-11874*# National Aeronautics and Space Administration, Washington, D.C.
GENERAL PRINCIPLES CONCERNING THE REACTION OF THE ORGANISM TO THE COMPLEX ENVIRONMENTAL FACTORS EXISTING IN SPACECRAFT CABINS [OBSHCHIYE ZAKONOMERNOSTI REAKTSIY ORGANIZMA CHELOVEKA NA KOMPLEKSNOYE VOZDEYSTVIYE FAKTOROV SREDY, KHARAKTERNYKH DLYA KABINY KOSMICHESKIKH LETATEL'NYKH APPARATOV]
A. V. Lebedinskiy, S. V. Levinskiy, and Yu. G. Nefedov Dec. 1964 15 p Transl. into ENGLISH of a paper Presented at the 15th Intern. Astron. Congr., Warsaw, 7–12 Sep. 1964
(NASA-TT-F-273) OTS Prices: HC $0.50/MF $0.50

Special relationships arising between the organism and the medium in a hermetically sealed space, as well as the influence of such factors as ionizing radiation, moderately high air temperature, and noise, coupled with the absence of ultraviolet radiation and consequences of restricted motor activity are considered. Chamber tests were carried out lasting from 10 to 120 days, in the course of which a study was made of the medium forming in the chamber as a result of the vital activity of man and of his reactions under these conditions. In the analysis of the results, attention is drawn to the nature of the changes rather than individual differences due to metabolism of different people. The problem of the psychic compatibility of several people who are isolated in a restricted space is also discussed. D.S.G.

N65-11890# Albert Einstein Medical Center, Philadelphia, Pa.
METABOLIC AND FUNCTIONAL CHANGES IN THE HEART DURING PROLONGED HYPOTHERMIA
C. Russ and J. C. Lee Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Sep. 1964 12 p refs
(Contract AF 41(657)-417)
(AAL-TDR-64-4; AD-608212)

The effect of hypothermia of 25° C for 24 hours on myocardial metabolism and efficiency was determined on dogs fasted for approximately 15 hours and anesthetized with sodium pentobarbital. Coronary blood flow, cardiac output, myocardial oxygen and substrate utilization, and mechanical efficiency of the heart were determined at normal and reduced body temperatures. Prolonged reduction of myocardial temperature, with concomitant reduction in coronary blood flow, led to diminished oxygen and substrate utilization. Myocardial glycolysis began following 12 hours of cooling when pyruvate utilization stopped in negative balance. After 24 hours the heart stopped utilizing carbohydrates, with negative arteriovenous differences for these substrates (in the presence of normal arterial carbohydrate levels), but continued to utilize nonesterified fatty acid. The coefficient of oxygen utilization for the heart increased following 24 hours of cooling. Hypoxia and glycolysis appeared during the late hours of cooling. Author

N65-11896# Air Force Systems Command, Wright-Patterson AFB, Ohio Aerospace Medical Research Labs.
RESPIRATORY AND MICROCLIMATE TEMPERATURES WITHIN THE PARKA HOOD IN EXTREME COLD Final Report, Dec. 1963

James H. Veghte Sep. 1964 11 p refs
(AMRL-TDR-64-79; AD-608139)

The standard Air Force arctic clothing was worn to determine whether or not it provided adequate head protection in extremely cold temperatures. Subjects were exposed to −62° C for 40 to 50 minutes in an environmental chamber. Possible respiratory problems and frostbite of the cheeks and nose were the primary concern. Subjects resting or exercising experienced no respiratory or frostbite problems. Air in the hood rapidly approached ambient conditions, because of the expulsive nature of expiration and the strong convective air movement. Exercise increased the microclimate temperatures in the hood. The existing hood design was found to provide adequate head protection for AF personnel at more extreme temperatures than are normally encountered in the Arctic. Author

N65-11900# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INSTRUMENT FOR RECORDING THE PULSE WAVES AND DETERMINING THE BLOOD PRESSURE IN ANIMALS
A. A. Kudryavtsev 26 Mar. 1964 6 p Transl. into ENGLISH from Veterinariya (USSR), no. 3, 1959 p 76–78
(FTD-TT-63-1176/1+2; AD-600148)

Various devices and methods for measuring the blood pressure of animals are described. It is stated that the most suitable apparatus for measuring blood pressure is the spring tonometer, which is described at length. D.E.W.

N65-11908*# National Aeronautics and Space Administration, Washington, D.C.
THE BIOLOGICAL EVALUATION OF RADIATION CONDITIONS ON THE PATH BETWEEN THE EARTH AND THE MOON [BIOLOGICHESKAYA OTSENKA RADIATSIONNYKH USLOVIY NA TRASSE ZEMLYA-LUNA]
Yu. M. Volynkin, A. V. Antipov, V. A. Guda, M. D. Nikitin, and P. P. Saksonov Dec. 1964 15 p refs Transl. into ENGLISH of a paper Presented at the 15th Intern. Astron. Congr., Warsaw, 7–12 Sep. 1964
(NASA-TT-F-279) OTS Prices: HC $0.50/MF $0.50

This report briefly reviews the physical characteristics of the basic types of cosmic radiation in near-earth space, and determines the quantities of biological doses created by each type of radiation. It shows that in flight along the trajectory around the moon during the quiet activity of the sun, a shield of 1 to 2 g/cm^2 will provide crew members protection against the danger of irradiation. Protons that are regenerated during a chromospheric flare on the sun represent a real threat to the health and life of the astronauts. Several methods and sources are discussed for protecting man from the damaging action of cosmic radiation in his flight from the earth to the moon. Author

N65-11931# Argonne National Lab., Ill.
BIOLOGICAL AND MEDICAL RESEARCH DIVISION Semiannual Report, Jul.–Dec. 1963
S. Phyllis Stearner et al Jun. 1964 135 p refs
(Contract W-31-109-ENG-38)
(ANL-6906) OTS: $4.00

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26. FINE STRUCTURE OF THE LACUNAE AND CANALICULI IN BONE F. Wassermann and James A. Yaeger p 118–125 refs

27. VARIOUS ASPECTS OF FIXATIVES FOR ULTRATHIN SECTIONS AND RESOLUTION IN ELECTRON MICROSCOPY Theodore N. Tahmisian, Carol J. Christiansen, Rosemarie L. Devine, and Betty Jean Wright p 126–129 refs

N65-11959# Naval Radiological Defense Lab., San Francisco, Calif.

DNA SYNTHETIC RATES AND CHROMOSOME REPLICATION IN GENERATING MARROW CELLS

E. L. Alpen and D. Cranmore 31 Aug. 1964 19 p refs

(USNRDL-TR-779; AD-450347)

The normally dividing bone marrow cells of the domestic cat provide suitable material for the examination of DNA replication patterns in individual chromosomes. Autoradiographic studies of chromosomes labeled with tritiated thymidine indicate a direct relation of chromosome size to duration of DNA synthetic activity of the 10 hours of the S-period studied. In this same period dividing cells achieved a maximum labeling of 80%. This suggests that a portion of the normally dividing cell population undergoes an arrest of considerable length in the G^2-period. Author

N65-12007# School of Aerospace Medicine, Brooks AFB, Tex. Dental Sciences Div.

REDUCTASE ACTIVITY AND SULFHYDRYLS IN THE DEHYDROGENASE HISTOCHEMISTRY OF HUMAN GINGIVA

William A. Gibson and Ira L. Shannon Sep. 1964 10 p refs

(SAM-TDR-64-48; AD-450950)

The nonenzymatic reduction of Nitro BT was studied in human gingival tissue sections at a pH of 7.5 and incubation times of 30, 60, 90, and 120 minutes in mixtures of Nitro BT and NAD, with and without the addition of respiratory inhibitors. The presence of cyanide but not Amytal or azide resulted in time increases in Nitro BT reduction. The reduction of disulfide to sulfhydryl groups by cyanide under histochemical conditions was demonstrated by the reduction of Nitro BT, which occurred after blocking of tissue sulfhydryl groups by pretreatment with n-ethyl maleimide. Using the DDD method of Barrnett and Seligman for sulfhydryls it was found that an increased sulfhydryl activity occurred after preincubation in mixtures containing cyanide. A slight but significant increase in sulfhydryl activity was also noted after preincubation in mixtures containing a coenzyme-dependent or coenzyme-independent substrate. Author

N65-12032# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

BIOSYNTHESIS OF PROTEIN

M. F. Gulyy 5 Aug. 1964 321 p refs Transl. into ENGLISH of the book "Biosintez Belka" Kiev, Izd. Akad. Nauk Ukr. SSR, 1963 p 5–204

(FTD-TT-63-1219/1+2; AD-607905)

The problems of protein biosynthesis and the role of proteolytic enzymes in the synthesis of plasteins (proteinlike substances) are treated in detail. The problems of enzymatic synthesis of protein under high pressure and of transpeptidase functions of proteases are examined. The biosynthesis of protein, in connection with other processes that serve as energy sources, is presented in detail. The enzymatic systems concerned in the process of activation of amino acids and of polypeptides and ammonia, and also the structure, properties, and role of soluble ribonucleic acid in this process are described. The significance of the microsomes and high-polymer nucleic acids, of lipids, and of vitamin B_{12} in protein biosynthesis, the problems of coding, the possibility of nonenzymatic incorporation of amino acids into protein, and other problems are also examined. Author

N65-12045# California U., Los Angeles

BEHAVIORAL AND NEUROPHYSIOLOGICAL STUDIES OF UDMH IN THE CAT Technical Report, May 1962–Jul. 1964

M. D. Fairchild and M. B. Sterman Wright-Patterson AFB, Ohio, AMRL, Sep. 1964 30 p refs

(Grant DA-CML-18-108-C-51)

(AMRL-TDR-64-72; AD-608089)

Studies concerning the behavioral and neurophysiological actions of UDMH in cats were carried out employing three separate experimental approaches: (1) Collection of behavioral and electrophysiological data from animals prepared with indwelling recording electrodes and isolated in a controlled environment after various doses of UDMH; (2) determination of thresholds for seizure induction by electrical stimulation of the hippocampus in unanesthetized, but immobilized "acute" preparations; and (3) development of a unique behavioral apparatus, which provides for the evaluation of subconvulsive doses of UDMH in relation to specific CNS regulatory mechanisms. The latter experiment has not yet reached the stage of UDMH administration and testing. The first set of experiments disclosed a direct relationship between dose and time of onset of characteristic behavioral and EEG signs preceding convulsions. The acute experiments indicate an initial increase in ventral hippocampal seizure threshold after administration of low doses of UDMH. Author

N65-12067# Maryland U., College Park

SPECTRAL SENSITIVITY OF SMALL RETINAL AREAS Final Progress Report, Jan. 1–Jul. 31, 1964

John Krauskopf 31 Jul. 1964 14 p refs

(Contract DA-49-193-MD-2327)

(AD-448595)

Work on four projects is reported: (1) ophthalmoscopic investigations of the physical basis of the Stiles–Crawford effect, which indicate that the change in reflectivity is greatest for the center of the pupil and falls off toward the margin; (2) study of average evoked potentials following saccadic eye movements, which indicates that amplitude and latency are dependent on the luminance of the steadily viewed fixation target; (3) theoretical analysis of the effects of small monochromatic stimuli; and (4) behavioral studies of the spectral sensitivity of the turtle. M.P.G.

N65-12074# Joint Publications Research Service, Washington, D.C.

RADIOACTIVITY AND DOSIMETRIC CONTROL

A. S. Srapionov 1 Dec. 1964 73 p refs Transl. into ENGLISH of excerpts from the book "Radioaktivnost' i Dozimetricheskiy Kontrol'" Tashkent, Nauka Publishing House, 1964

(JPRS-27625; TT-64-51836)

This study pertains to the construction and safety shielding of laboratories for processes employing polonium–beryllium

and radium–beryllium neutron sources. Calculations for the shielding against powerful neutron streams were performed. A combination of several shielding materials is recommended, consisting of a layer of paraffin, a layer of a neutron absorbent (boric acid, boron carbide, or cadmium sheet), and an inner core of cast iron or lead. The reliability and quality of the shielding was verified with dosimetric instruments by measuring the flux of fast neutrons, and a maximum permissible overall radiation level of 0.1 re per man per week was established as a safety standard. G.G.

N65-12131# Lankenau Hospital, Philadelphia, Pa. Div. of Research

CARDIODYNAMIC AND METABOLIC EFFECTS OF PROLONGED BED REST WITH DAILY RECUMBENT OR SITTING EXERCISE AND WITH SITTING INACTIVITY

N. C. Birkhead, J. J. Blizzard, J. W. Daly, G. J. Haupt, B. Issekutz et al Wright-Patterson AFB, Ohio, AMRL, Aug. 1964 31 p refs

(Contract AF 33(657)-9049)

(AMRL-TDR-64-61; AD-607239)

Eight healthy men were studied to evaluate the modifying effects of supine or sitting exercise or quiet sitting on the circulatory and metabolic consequences of prolonged bed rest. They were fed a weighed formula-type diet of 2500 calories (78 gm protein, 71 gm fat, 390 gm carbohydrate, and 1.630 gm calcium) throughout the study. Urinary nitrogen, calcium, and phosphorus excretions were determined from 6-day pooled samples. Four subjects remained at recumbent bed rest for 24 days except for 1 hour daily lying (2 subjects) or sitting (2 subjects) bicycle ergometer exercise, and four subjects remained at recumbent bed rest for 16 hours and sat quietly in a chair for 8 hours daily for 30 days. All subjects underwent physical training for 18 days before and after these periods of inactivity. Author

N65-12171# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CHANGES IN THE CONTENT OF BIOLOGICALLY ACTIVE SUBSTANCES IN RATS UNDER THE ACTION OF RADIAL ACCELERATIONS

I. M. Khazen and I. L. Vaysfel'd 17 Aug. 1964 12 p refs Transl. into ENGLISH from Voprosy Med. Khim. (Moscow), v. 8, no. 5, 1962 p 493–497

(FTD-TT-64-202/1+2; AD-607878)

Rats underwent positive as well as negative acceleration up to 10 g for a 1-minute duration in the direction of the inertial forces at a rate of 2 g/sec. After this action was repeated up to 120 times, the animals were killed, and the histamine level in their blood and tissues was measured. In general, a lowering of the histamine level and of the contents of adrenalinlike substances in the mucous membrane of the intestine and in the tissues of the brain was observed. The excretion of 5-oxyindoluxus acid with the urine was also reduced, the quantity depending on the magnitude, frequency, and duration of the acceleration exposure. G.G.

N65-12183# Joint Publications Research Service, Washington, D.C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 125

24 Nov. 1964 19 p Transl. into ENGLISH from Chinese Periodicals

(JPRS-27506; TT-64-51755) OTS: $1.00

Translated articles are presented on the prevention of sweetpotato mildew, on the advance in aeronautical training, on the Nanking Aeronautical College, and on the progress of the Peking Aeronautical College. The translation of a letter to the editor of "Aeronautical Knowledge" (a journal) that asks how to enter an aeronautical college is also included, along with the editor's reply. D.E.W.

N65-12189# American Foundation for Biological Research Madison, Wis.

DIRECT OBSERVATIONS ON THE MODE OF INVASION OF LIVING TISSUES BY ICE

B. J. Luyet, R. J. Williams, and P. M. Gehenio Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Aug. 1964 28 p refs

(Contract AF 41(657)-343)

(AAL-TDR-63-26; AD-608211)

Direct observations, during freezing, of pieces of frog tissues or organs (mesentery, nictitating membrane, lung, pericardium, and muscle) were made by means of the apparatus for cryomicroscopy developed earlier in this laboratory. A copper-wire microheater, inserted in the preparation, permitted local heating and control of the advance or retreat of the ice front. Three stages in the ice invasion of tissues were noted: (1) Superficial freezing—at high subzero temperatures, a flimsy blanket of ice spreads over and underneath the thin layer of tissue; the advance of this blanket is generally unaffected, as to direction, by the underlying structures. (2) Intercellular freezing—at slightly lower temperatures, ice from the superficial layer is seen to spread between the cells; the advancing ice front sometimes uses tissue elements, like bundles of collagenous fibers, as pathways. (3) Intracellular freezing—at still lower temperatures, ice enters the cells; the point of entrance can often be identified; the red blood cells are seen to freeze individually and suddenly. Author

N65-12219 # National Aeronautics and Space Administration, Washington, D.C.

RESULTS OF MICROBIOLOGICAL AND CYTOLOGICAL INVESTIGATIONS ON VOSTOK TYPE SPACECRAFT [ITOGI MIKROBIOLOGICHESKIKH I TSITOLOGICHE SKIKH ISLEDOVANIY NA KOSMICHESKIKH KORABLYAKH TIPA "VOSTOK"]

N. N. Zhukov-Verezhnikov et al Dec. 1964 9 p refs Transl. into ENGLISH of a paper presented at the 15th Intern. Astronautical Congr., Warsaw, 7–12 Sep. 1964

(NASA-TT-F-281) OTS Prices: HC $0.50/MF $0.50

Numerous ground-based experiments showed that lysogenic bacteria by virtue of their pathological bacteriophage information are highly sensitive to ionizing radiation and ultraviolet rays. It is a well-known fact that human cells in monolayer cultures are also sensitive to these factors. Therefore, beginning with the second spacecraft and thereafter on vehicles of the Vostok type, experimental use was made of the lysogenic bacteria *E. coli* K-12 (λ), of cultures of normal and cancerous human cells (strains of fibroplasts, amnion, Hela), and of some other biological objects. The experiments showed that increase in length of flight is associated with intensified bacteriophage production by the lysogenic culture and slight changes in the nature of the growth of the normal and cancerous cell cultures. The biological effect noted in the experiments on Vostoks 3, 4, 5, and 6 seems to have been caused by a set of space flight factors, radiation and vibration in particular. As was demonstrated in the ground-based experiments, vibration helped to sensitize cells of the lysogenic culture to gamma irradiation (Co^{60}). Author

N65-12246# Duke U., Durham, N.C.
STUDY OF THE DYNAMICS OF THE LUNG-THORAX SYSTEM Final Report
Wayland E. Hull and E. Croft Long 15 May 1964 11 p refs
(Contract Nonr-1181(07))
(AD-606521)

The response was observed of the thoraco–abdominal system in dogs that underwent force ventilation by sinusoidally varying pressure in a whole-body respirator. The tidal volume, the intrathoracic pressure, the driving pressure in the respirator, and the instantaneous rate of airflow were measured, and the various breathing frequencies were calculated from the gained data. It was found that an increase in driving pressure resulted in a decrease of the apparent resonant frequency, and that all respiratory subsystems acted in concert to serve the common purpose of the carbon dioxyde–oxygen exchange. A digital-computer program was designed that correlated several parameters of the respiratory system, and is to be used for further reduction of analog data to a form for use in an IBM analysis. G.G.

N65-12268*# National Aeronautics and Space Administration, Washington, D.C.
CONCEPTS FOR DETECTION OF EXTRATERRESTRIAL LIFE
Freeman H. Quimby, ed. 1964 52 p refs
(NASA-SP-56) GPO Price: $0.50; OTS Price: MF $0.50

The following subjects are presented: "Evidence Relevant to Life on Mars"; "Mars Surface High-Resolution Near-Scan TV"; "The Vidicon Microscopes"; "The Gas Chromatograph"; "The Mass Spectrometer"; "The Ultraviolet Spectrophotometer"; "The J-Band Life Detector"; "Optical Rotation"; "The Radioisotope Biochemical Probe: Gulliver"; "The Wolf Trap"; "The Multivator Life-Detection System"; and "The Mars Mariners and Voyagers." G.G.

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-11016# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PRELIMINARY RENDEZVOUS EXPERIMENTS DEFINITION AND DESIGN
D. W. Eliason, R. S. Lincoln, and T. S. Merriman 1 Sep. 1964 35 p refs
(LMSC-6-62-64-13)

This report describes a man-in-the-loop terminal rendezvous experiment, which is based on the principles of experimental design theory. A detailed discussion of the experimental design, the task description, and pilot instructions are included, as well as a discussion of the experimental equipment and procedure. Author

N65-11019*# Space Technology Labs., Inc., Redondo Beach, Calif.
A STUDY OF MANUAL CONTROL METHODOLOGY WITH ANNOTATED BIBLIOGRAPHY
L. G. Summers and K. Ziedman Washington, NASA, Nov. 1964 205 p refs
(Contract NASw-717)
(NASA-CR-125) OTS Prices: HC $3.50/MF $1.25

Two general classifications of approaches toward describing the human being as a controller are reviewed. The first is the study of perceptual motor behavior, as performed by the general or engineering psychologist. The second is the application of mathematical models, based on control theory to the description of the human operator. Differences and similarities in the two approaches are discussed, and the most useful aspects of each are pointed out. Areas for future study are suggested. R.L.K.

N65-11043*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
FIXED-BASE-SIMULATOR EVALUATION OF A PILOT'S TERRAIN-FOLLOWING DISPLAY WITH VARIOUS MODES OF PRESENTING INFORMATION
Thomas E. Wempe Washington, NASA, Nov. 1964 40 p refs
(NASA-TN-D-1827) OTS Prices: HC $1.00/MF $0.50

An exploratory study was made of human ability to use a visual display to guide a high-speed aircraft in close proximity to the terrain. The control dynamics of a small aircraft flying near sea level at Mach 1.2 were simulated on an analog computer interconnected with a two-axis side-arm controller and a cathode-ray-tube display. The pilot's task was to guide the aircraft as closely as possible to simulated terrain while minimizing a heading error. No motion cues or other environmental stresses were provided. The pilot's performance was markedly influenced by variations in the visual display of the aircraft attitude and position relative to the terrain. A 1 1/2-hour sustained terrain-following task with this fixed-base simulation revealed no major degradation in pilot performance. Author

N65-11082# Air Force Systems Command, Wright-Patterson AFB, Ohio Behavioral Sciences Lab.
PROGRAMED INSTRUCTION—PAST, PRESENT, FUTURE
John S. Abma Sep. 1964 17 p refs
(AMRL-TR-64-89; AD-607809)

Programed instruction has existed in its present forms for approximately ten years. Three major approaches are adjunct autoinstruction, intrinsic programing, and linear programing. Most current research is centering on linear programing. Results indicate that programed instruction is successful in some applications, but not the answer to all training problems. The future may see an integration of programed instruction and other training techniques within a systems approach to training and education. Author

N65-11096# Naval School of Aviation Medicine, Pensacola, Fla.
THE RELATIONSHIP OF SMALL VISUAL ACUITY DEFECTS TO THE ABILITY TO COMPLETE FLIGHT TRAINING AND PERFORM IN OPERATIONAL FLYING. A Ten-Year Progress Report
Wayne L. Erdbrink and Robert E. Kinneman 9 Apr. 1963 12 p
(Rept.-2; AD-600977)

At the end of a 10-year period, 116 men with small visual acuity errors have had an opportunity to complete flight training as a result of this study. Eighty-four of these actually completed training and have been designated naval

aviators. The attrition rate in training and in the fleet compares quite favorably with what is seen overall in visually qualified subjects. There has been no attrition resulting from progressive myopia or other visual defects in any of the student aviators or first tour pilots of this group. Only four aviators from this study (4.9% of those designated) have been grounded as a result of decreased visual acuity, and all of these had completed their obligated service prior to grounding. Author

N65-11099# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AUTOMATION TODAY AND TOMORROW Collection of Articles
D. M. Berkovich et al 20 Oct. 1964 58 p ref Transl. into ENGLISH from "Avtomatizatsiya Segodnya i Zavtra" Moscow, Izd. Znaniye, 1963, ser. 4 p 1–40
(FTD-MT-64-188; AD-607856)

This is a discussion of the first volume of the encyclopedia "Automation of Production and Industrial Electronics." The development of the cybernetic technology as an important prerequisite of new technical and scientific approaches to liberate mankind from dehumanization by machines is emphasized. The following topics are presented: "Main Trends in the Development of Automation"; "Arming Personnel with Advanced Science"; "Some Problems of Radio Electronics"; "Creative Collaboration of Engineers and Biologists"; "Persistently Develop the Theoretical Bases of Automation"; "Electronic Technology at the Service of Automation"; and "Mathematical Problems of the Organization of Production." G.G.

N65-11415# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
A ZERO GRAVITY PELLET DISPENSER FOR USE WITH PRIMATES IN LONG-TERM SPACE FLIGHTS Technical Documentary Report, 15 Apr.–1 Sep. 1964
Gregg A. Gilbert Oct. 1964 14 p ref
(Contract AF 29(600)-4076)
(ARL-TR-64-15; AD-450731)

This report describes a device that can be used to dispense food pellets to primates in a zero-gravity environment. The device is controlled electronically, but the food is delivered mechanically when a lever is actuated. The feeder has a capacity for enough food to sustain a 50-pound chimpanzee for as long as 30 days. Author

N65-11484# Duntley (S.Q.), La Jolla, Calif.
SURVEY OF RESEARCH RELATING TO MAN'S VISUAL CAPABILITIES IN SPACE FLIGHT Final Report
John H. Taylor Jun. 1964 81 p
(Contract NObs-86012)
(AD-606802)

All phases of space travel are considered, from initial launch through various inflight tasks, lunar and planetary exploration, relaunch from an extraterrestrial body, and eventual return to earth. Information garnered from literature on past research and from groups presently involved in work on these subjects is presented by the type of visual task involved. These tasks are orientation, rendezvous and docking, navigation, observation of earth and extraterrestrial bodies from the upper atmosphere, space astronomical observations, observation of the lunar surface and of planetary surfaces from close orbits, lunar and planetary landings with estimates of distance and closure rates, observation of the lunar surface, planetary landing, translation on the lunar surface and extravehicular maintenance. D.E.W.

N65-11573# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
THE DESIGN OF A CANINE INHALATION EXPOSURE APPARATUS INCORPORATING A WHOLE BODY PLETHYSMOGRAPH Technical Progress Report
B. B. Boecker, F. L. Aguilar, and T. T. Mercer Oct. 1964 70 p refs
(Contract AT(29-2)-1013)
(LF-16) OTS: $1.00

A whole-body plethysmograph has been incorporated in an apparatus for exposing dogs individually to radioactive aerosols. This makes it possible to monitor the dog's respiratory pattern during the exposure without the use of any respiratory masks or valves. After three different transducer systems were evaluated for use with the plethysmograph, the flow-rate transducer was chosen for several reasons, including the fact that this system produces inspiratory and expiratory flow-rate data, as well as tidal volume and respiratory rate information. The aerosol is continuously produced and drawn past the dog's nose during the exposure period, and provision has been made for quantification of the aerosol in terms of concentration and particle-size distribution for each experiment. Author

N65-11638# Cincinnati U., Ohio Research Foundation
SHORT-TERM MEMORY AS A PREDICTOR OF TROUBLE-SHOOTING SKILLS
R. J. Senter and B. R. Bernstein Jul. 1963 8 p refs
(Contracts AF 33(616)-7674; AF 33(616)-6835)
(AMRL-MEMO-P-53; AD-602539)

The Short-Term Memory Test consisted of 21 subtests, or sets of different items. Each subtest was studied by the subject for a specified short period, then it was removed and the subject's memory of the materials was tested. Various types of tests of memory were used, e.g. reconstruction, true-false, multiple choice, etc. Performance on the Short-Term Memory Test correlated significantly with some measures of learning to troubleshoot some equipment. Higher correlations were obtained when subjects received incentive pay for better performance on the Short-Term Memory Test. Under the condition of incentive pay, the correlations between short-term memory and learning to troubleshoot were generally comparable to the correlations obtained between learning to troubleshoot and standard tests of symbolic reasoning and verbal reasoning. Author

N65-11667# Chicago U., Ill. Committee on Mathematical Biology
AN ANALOG COMPUTER MECHANIZATION OF THE HODGKIN–HUXLEY EQUATIONS
Hugo M. Martinez 1 Oct. 1964 24 p refs
(Grants AF-AFOSR-370-63; PHS-G-CA-06475-03)
(AD-608156)

The Hodgkin–Huxley equations describing the action potentials for giant squid axons have been mechanized on an analog computer for the purpose of simulating a variety of experimental situations. The mechanization is described together with the following results: (1) response to constant currents ranging from threshold to saturation; (2) response to a 100-cps sinusoidal current at two amplitudes and two phases; and (3) the effect of removing the potassium current term. Author

N65-11717# Naval Research Lab., Washington, D.C. Organic and Biological Chemistry Branch
PRESSURE AS A FACTOR IN ALGAL GROWTH
P. J. Hannan *In its* Rept. of NRL Progr. Sep. 1964 p 11–17 refs (See N65-11715 02-11) OTS: $1.25

Photosynthesis by algae is being considered as a possible source of oxygen on board submarines. Pressure is one of many variables being studied in an effort to obtain the maximum production of oxygen from a system in which algal cultures are employed. It was found that pressure is either an advantage or a detriment, depending on the flow rate and the amount of carbon dioxide fed into the system. Author

N65-11772# Air Force Systems Command, Wright-Patterson AFB, Ohio Aerospace Medical Research Labs.
TEST AND EVALUATION OF QUALITATIVE AND QUANTITATIVE PERSONNEL REQUIREMENTS INFORMATION
Evan D. Stackfleth Sep. 1964 26 p refs
(AMRL-TDR-64-65; AD-607781)

Some of the problems in the validation of personnel requirements developed and predicted in the Qualitative and Quantitative Personnel Requirements Information reports are described. Included are problems inherent in the validation procedures, such as the nature of the predictor (QQPRI), the problem of criterion selection and bias, and the changing nature of the criterion. Because of the multiple nature of these problems, available testing techniques are not adequate to handle the testing and to provide desired information. A solution is presented. This solution requires a procedural change whereby validations are conducted during different but specific stages of system development and test. The validations would be oriented to obtaining the best validation at a particular time and for a particular purpose rather than attempting an overall test. Methods are suggested for determining manning deficiencies and readjusting the personnel subsystem. Author

N65-11774# Air Force Systems Command, Bedford, Mass. Decision Sciences Lab.
DECISION SCIENCES LABORATORY BIENNIAL PROGRESS REPORT, JULY 1962–JUNE 1964
Walton F. Dater, Jr. Oct. 1964 47 p refs
(ESD-TDR-64-609; AD-607443)

Progress is reported in five areas of man–machine interaction: data presentation and display; learning, problem solving, and decision making; programed teaching and automated training; communications; and direct applications of principles and techniques to military information systems and situations. R.L.K.

N65-11817# Dunlap and Associates, Inc., Darien, Conn.
DEVELOPMENT OF A MAN-COMPUTER SYSTEM FOR SOLVING A TARGETING PROBLEM
Ugo O. Gagliardi [1964] 22 p ref Presented at the Western States Navy Res. and Develop. Clin., Montana State Coll., Bozeman
(Contract Nonr-3602(00))
(AD-607520)

This study was conducted to develop a method for the design of computerized problem-solving aids. The method relies on the observation of problem-solving behavior, and utilizes the evidences of heuristic procedures displayed by the subject as indicators of processing overloads. This information is, in turn, used to formulate problem-solving aids whose effectiveness is verified experimentally. The problems used were selected because they have a formal structure that admits many interpretations—from the design of minimal switching circuits to the disposition of weapon systems. The subject's task was to allocate hypothetical missile-firing submarines so that a specified number of targets were covered by the fewest possible ships. This task is formulated as a linear integer programming problem that was solvable by Gomory's algorithm. Complete automation of the task, using this algorithm, was undesirable because the procedure was excessively time consuming when more than a few solutions were required. Experiments indicated that the subject's processing limitations resulted in a slow and biased search for elements from which to assemble solutions. The aided system delegated the subtask of finding key elements to an automated process, and let the person assemble these elements into deployments. The effectiveness of this arrangement was shown by the fact that aided subjects found more solutions and more uniformly distributed solutions than unaided subjects. Author

N65-11895# Air Force Systems Command, Wright-Patterson AFB, Ohio Aerospace Medical Research Labs.
REACH CAPABILITY OF THE USAF POPULATION. PHASE I: THE OUTER BOUNDARIES OF GRASPING-REACH ENVELOPES FOR THE SHIRT-SLEEVED, SEATED OPERATOR Final Report, Jan. 1960–Jan. 1962
Kenneth W. Kennedy Sep. 1964 89 p refs Statistical Reductions performed by Antioch Coll.
(Contract AF 33(616)-6792)
(AMRL-TDR-64-59; AD-608269)

This report contains descriptions of the outer boundaries of the minimum, 5th-, 50th-, and 95th-percentile grasping-reach envelopes of seated, shirt-sleeved operators. The two most important are the minimum and 5th-percentile envelopes. These envelopes have been calculated to permit 99+ percent or 95 percent of the Air Force population, respectively, to reach any point at their boundaries. The report contains a critical resume of previous investigations of arm reach and a description of the AMRL Grasping-Reach Measuring Device. The data-gathering and statistical procedures are included, and applications of the reach envelopes are discussed. Horizontal contours representing the outer boundary of the minimum, 5th-, 50th-, and 95th-percentile grasping-reach envelopes are presented for each 5-inch level beginning at 5 inches below SRP (Seat Reference Point) and extending to 50 inches above SRP. The minimum envelope extends from 2.5 inches below SRP to 48 inches above; the 5th-percentile envelope from 4 inches below SRP to 48.75 inches above. Horizontal distances from SRP to the boundary of each envelope are given at 15° intervals. Author

N65-11898# Ohio State U. Research Foundation, Columbus
ON THE STRUCTURE AND ORGANIZATION OF THE NERVOUS SYSTEM FROM AN INFORMATION PROCESSING POINT OF VIEW (NEURAL CODING, VISION, AND MOTOR CONTROL) Final Report, Oct. 1962–Mar. 1964
N. A. Coulter, Jr. Wright-Patterson AFB, Ohio, AMRL, Oct. 1964 101 p refs
(Contract AF 33(657)-9660)
(AMRL-TR-64-80; AD-608284)

A study was made of the central nervous system from an information processing point of view. The study entailed a review and critical analysis of several hundred references, and involved a considerable amount of recasting and reorganization of existing knowledge into the terms and concepts of engineering, with particular reference to potential bionic applications. The study was selective rather than comprehensive. The neural coding problem was first examined, the history of efforts dealing with this problem was reviewed, and a mathematical representation of neural signals (neurograms) and neural operators was formulated. The processing of data by the visual system was then described, with particular reference to form, color, and

image fixation, automatic focusing control, intensity control, image fusion, depth perception, and the stabilization of visual space. Next, the neural control of movement was analyzed from a servomechanical viewpoint. The unit biomechanical control system was defined, and the corticospinal command of this unit system was discussed. The cerebellar coordination and extrapyramidal stabilization of sequences and combinations of biomechanical control unit actions were examined. Finally, the ability of the central nervous system to generate its own goals—a capability for which no technological counterpart yet exists—was discussed, and a preliminary sketch of a theory of teleogenetic systems was presented. Author

N65-11899# Applied Science Associates, Inc., Valencia, Pa.
A FIELD EXPERIMENTAL STUDY OF PROGRAMMED INSTRUCTION ON A MANIPULATIVE TASK Final Report, Aug. 1963–Dec. 1963
John D. Folley, Jr. (AMRL), Aubrey J. Bouck, and John P. Foley, Jr. Wright-Patterson AFB, Ohio, AMRL, Oct. 1964 47 p
(Contract AF 33(657)-11358)
(AMRL-TR-64-90; AD-608296)

Approximately 1300 basic military trainees were used in a 3 X 7 factorial study of modes and content of training on a manipulative performance task—the assembly and disassembly of the M1 carbine. The modes of training included lecture–demonstration, a printed linear program with or without an answer sheet, and an audio-visual program presented by an audio-visual device or by a printed booklet. Also evaluated was a condition in which the trainees tried to perform the final task and were assisted as required. The content of the training was varied by providing training on assembly only, or disassembly only, or both. The final criteria were the time and the number of assists required to disassemble and assemble the M1 carbine. Although the modes of training differed significantly, the rankings were very different on the two criteria. No mode of training seemed clearly superior to the other modes. The audio-visual program presented in the printed booklet seemed somewhat inferior. Training on only the assembly of the carbine resulted in as good performance as training on both assembly and disassembly. The findings probably can be generalized only to relatively simple procedural-type tasks. Replication of the study with more complex performance tasks is recommended. Author

N65-11933# Joint Publications Research Service, Washington, D.C.
HYGIENIC STANDARDS FOR CONSTANT NOISE IN INDUSTRY
A. A. Arkad'yevskiy 27 Nov. 1964 10 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), no. 7, Jul. 1964 p 25–30
(JPRS-27559; TT-64-51807) OTS: $1.00

The normal levels of steady noise in industry were studied, with special attention being given to the levels at which no disturbance of hearing sensitivity occurs. It was concluded that noise is harmless at intensities of 90, 85, 75, and 65 decibels, with peak sound pressures at frequencies of 200, 600, 1250, and 4000 cycles per second, and that brief noises with the same maximum levels of sound energy but with intensities of 100, 90, 85, and 75 decibels differ, having an unfavorable fatiguing effect on the organism. Physiological data for the nonspecific effects of constant noise are given. D.E.W.

N65-12040# Ionics, Inc., Cambridge, Mass.
RECOVERY OF POTABLE WATER FROM URINE BY MEMBRANE PERMEATION Final Report, May 1963–Apr. 1964
Arthur W. Warner, Daniel L. Brown, and Werner Glass Wright-Patterson AFB, Ohio, AMRL, Sep. 1964 51 p refs
(Contract AF 33(657)-11353)
(AMRL-TDR-64-73; AD-607759)

An experimental program was conducted to determine the feasibility of using membrane permeation for the reclamation of potable water from human urine. On the basis of favorable results obtained in the feasibility study, a laboratory-model urine reclamation system was built. Model components selected were theoretically capable of operating in a zero-gravity environment to recover 5000 ml of water per 24-hr period. The laboratory model weighs about 128.5 lb, has a total component volume of about 2.0 ft^3, and requires approximately 262 W of power to operate. Energy requirement of the system is about 4.4 kW hours per 5000 ml of product. Excellent quality water is obtained from the system, using raw human urine as the feed source. Yields are above 85%. Author

N65-12055# Joint Publications Research Center, Washington, D.C.
BIONICS
L. P. Krayzmer 2 Dec. 1964 59 p refs Transl. into ENGLISH of the book "Bioniki" Tbilisi, State Publishing House "Soviet Georgia", 1963 p 1–93
(JPRS-27635; TT-64-51839) OTS: $3.00

This book describes basic questions of bionics as a scientific discipline that examines the possibility of applying knowledge of biologic processes and methods to engineering problems. Primary attention in this book is given to those questions dealing with perception, storing, transmitting, and converting information in living organisms, and with the possibility of applying this knowledge when working out technical cybernetic systems to increase their versatility, flexibility, and reliability. Author

N65-12076*# Boeing Co., Seattle, Wash.
MANNED ENVIRONMENTAL SYSTEM ASSESSMENT
Washington, NASA, Nov. 1964 337 p refs
(Contract NASw-658)
(NASA-CR-134) OTS Prices: HC $5.00/MF $1.75

A complete integrated life support system capable of providing life support for 5 men for 30 days was developed, designed, fabricated, and installed inside a variable altitude chamber for test. The first test attempt ended after 4 1/2 days because of crew illness and a catastrophic equipment failure. Prior to resumption of the second attempt all subsystems were reviewed for performance and modified as required to insure reliable mechanical operation. Trace contaminant studies were made resulting in the substitution of many equipment fabrication materials, additional filtration, and increased capacity air catalytic oxidization. The second attempt was successful. Discussed are all aspects of the program including systems, technology, behavioral, and medical and clinical. Individual development, subsystem and system tests, results, analyses, conclusions, and recommendations are included. Author

N65-12090# BioTechnology, Inc., Arlington, Va.
EFFECTIVENESS OF THREE VISUAL CUES IN THE DETECTION OF RATE OF CLOSURE AT NIGHT
James F. Parker, Jr., Robert R. Gilbert, and Richard F. Dillon Mar. 1964 51 p
(Contract CPR 11-8683)
(BTI-64-1)

This study was concerned with an evaluation of the visual cues used at night by a driver when he decides he is overtaking

the vehicle in front of him. The basic paradigm was one in which, for any given experimental trial, two of three visual cues (area, brightness, and visual angle) were manipulated so as to maintain an apparent constancy, while the third, the one on which the overtaking decision had to be made, was varied. The effectiveness of each cue was tested at three levels of cue intensity and at three speeds of approach. The following conclusions were drawn: (1) The control condition, in which normal taillights were used, is significantly superior to the operation of any single cue. (2) Both the visual-angle cue and the brightness cue are superior to the area cue. (3) The level of visual angle and of brightness was significant, whereas the level of area was not. (4) Approach speed did not influence effectiveness. (5) Sensitivity to change in visual-angle cue appears to conform to the Weber psychophysical function. D.S.G.

N65-12132# Ohio State U., Columbus
SUBJECT CONTROL OVER A BAYESIAN HYPOTHESIS-SELECTION AID IN A COMPLEX INFORMATION-PROCESSING SYSTEM Final Report, 1 Jun. 1963–15 Apr. 1964
Jack F. Southand, David A. Schum, and George E. Briggs Wright-Patterson AFB, Ohio, AMRL, Sep. 1964 46 p refs
(Contract AF 33(657)-10763)
(AMRL-TR-64-95; AD-608108)

An eight-man team produced evaluations of various threats posed by a hypothetical aggressor. These evaluations were made on the basis of intelligence information gathered on simulated reconnaissance overflights of the homeland area of the aggressor. The primary output from this threat evaluation team was a series of a posteriori probabilities estimations produced by the team's commanding officer (CO). In three of the four experimental conditions the CO was provided with a hypothesis-selection aid based upon a modification of Bayes' theorem (MBT). In these three conditions the CO was permitted to exert an increasing amount of control over the MBT-aid mechanism. He exerted control either by adjustment of certain parameters on the MBT model or by direct insertion of conditional probabilities into the model. The purpose of the experiment was to observe whether increasing control over the MBT-aid mechanism would increase the user's acceptance of the aid and improve his threat-diagnosis performance. Author

N65-12133# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio
A MATHEMATICAL MODEL OF THE HUMAN BODY Final Report, Jun. 1963–Aug. 1964
Ernest P. Hanavan, Jr. (M.S. Thesis) Oct. 1964 155 p refs
(GA/PHYS/64-5; AMRL-TR-64-102; AD-608463)

A mathematical model for predicting the inertial properties of a human body in various positions has been developed. Twenty-five standard anthropometric dimensions are used in the model to predict an individual's center of gravity, moments and products of inertia, principal moments, and principal axes. The validity of the model was tested by comparing its predictions with experimental data from 66 subjects. The center of gravity was generally predicted within 0.7 inches and moments of inertia within 10%. The principal vertical axis was found to deviate from the longitudinal axis of the body by as much as 50°, depending on the body position assumed. A generalized computer program to calculate the inertial properties of a subject in any body position is presented. Author

N65-12230# Lockheed Missiles and Space Co., Sunnyvale, Calif.
TERMINAL PHASE RENDEZVOUS CONTROL/DISPLAY OPTIMIZATION EXPERIMENTS (GENERAL DESCRIPTION)
V. E. Jones, Jr. 15 Sep. 1964 22 p refs
(LMSC-6-62-64-15)

This report describes a man-in-the-loop terminal-phase rendezvous, experimental study program. The primary objectives of this program are to develop design criteria and configurations for the terminal-phase rendezvous control-display subsystem. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-10968# Monsanto Research Corp., Dayton, Ohio
MOLECULAR STRUCTURE AND MATERIALS CHARACTERIZATION Technical Documentary Report, 1 Jul. 1961–15 Mar. 1964
J. E. Katon Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 19 p refs
(Contract AF 33(616)-8465)
(ML-TDR-64-157; AD-605313)

A brief summary of activities in the following areas is presented: (1) vibrational spectroscopy—study of skeletal bending vibrations of organic molecules; (2) polymer characterization—methods of evaluating the high-temperature properties of new materials; (3) mass spectrometry—the application of the spark ionization source to the study of solids; (4) gas–liquid chromatography—the collection of chromatographic eluates that can be identified by other means; and (5) service and support—method development and analytical support processes. P.V.E.

N65-10997# Pennsalt Chemicals Corp., King of Prussia, Pa. Research and Development Dept.
INORGANIC COORDINATION POLYMERS. VI: LINEAR DOUBLE-BRIDGED CHROMIUM (III.). PHOSPHINATE POLYMERS WITH INORGANIC SIDE GROUPS
A. J. Saraceno and B. P. Block Aug. 1964 24 p refs
(Contract Nonr-2687(00))
(TR-41; AD-605332)

This is an isothermal stability study of various linear double-bridged chromium (III) phosphinate polymers with inorganic side groups. The changes in intrinsic viscosity, infrared spectra, and solubility were investigated. It was found that changes in the polymer occur at temperatures as low as 265° C. Infrared spectra showed little or no change in the specimens up to 340° C. At 365° C, an abrupt decrease in the intensity of the broad OH peak occurred. The statistical data showed that the three variables of temperature, concentration, and solvent affected the rate of change for the used polymer samples, and an interaction of higher temperatures with greater polymer concentrations led to a significant additional increase in the intrinsic viscosity. G.G.

N65-11007# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
A REVIEW OF THE PHYSICS OF GAS ADSORPTION ON SOLID SURFACES
T. Luzzi Oct. 1964 46 p refs
(RE-185)

A qualitative and semiquantitative description of physical adsorption of gases and liquids on solid surfaces is presented.

The discussion is limited to those areas that might be most useful to those interested in the study of gas–surface interaction in rarefied gas dynamics. Physical adsorption is described from the macroscopic or thermodynamic viewpoint and the molecular viewpoint. Several physical adsorption theories are reviewed. Analysis indicates that a monolayer of gas molecules "skidding" over the surface in random directions as a two-dimensional gas is a reasonable model of physical adsorption in rarefied gas dynamics. Author

N65-11020*# General Dynamics Corp., Groton, Conn. Electric Boat Div.
THE SYNTHESIS AND UTILIZATION OF LOW MOLECULAR WEIGHT OZONIDES FOR AIR REVITALIZATION PURPOSES
A. W. Petrocelli and A. Capotosto, Jr. Washington, NASA, Nov. 1964 89 p refs
(Contract NASw-559)
(NASA-CR-135) OTS Prices: HC $2.25/MF $0.75

The chemistry of alkali metal ozonides has been studied from the point of view of their use in nonregenerative air-revitalization systems. Various methods have been explored for the synthesis of potassium, sodium, and lithium ozonides. The physical and chemical properties of potassium ozonide, which could be readily prepared in pure form (88% to 97%), have been characterized by studies of the compound's thermal stability, its reaction with water vapor, and its reaction with carbon dioxide. The handling and storage characteristics of potassium ozonide have also been determined. Theoretical discussions of chemical nonregenerative air-revitalization systems in general, and of the synthesis and chemistry of alkali metal ozonides in particular, are presented. Author

N65-11039# California Inst. of Tech., Pasadena Gates and Crellin Labs. of Chemistry
NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY: ANALYSIS OF THE PROTON SPECTRUM OF CYCLOBUTENE
Stanko Borčić and John D. Roberts Aug. 1964 17 p refs Submitted for Publication *Its* Contrib. No. 3156
(Contract Nonr-220(26))
(TR-33; AD-605677)

A complete analysis of the proton nmr spectrum of cyclobutene (I) has been made and shows that the couplings between the allylic and vinylic protons, while small, are by no means negligible; $J_{13} = -0.80$ cps and $J_{15} = +1.55$ cps. The analysis, which involved ^{13}C-satellite spectra of ordinary and specifically deuterated cyclobutene, gave spin-coupling and chemical shift parameters, predicting that cyclobutene should show just two quite sharp peaks in its high-resolution nmr spectrum in agreement with experiment. Author

N65-11042# California Inst. of Tech., Pasadena Gates and Crellin Labs. of Chemistry
NITROGEN-15 MAGNETIC RESONANCE SPECTROSCOPY. II: COUPLING CONSTANTS
Gerhard Binsch, Joseph B. Lambert, Bryan W. Roberts, and John D. Roberts Aug. 1964 31 p refs Submitted for Publication *Its* Contrib. No. 3099
(Contract Nonr-220(26))
(TR-31; AD-605675)

Coupling constants have been measured between nitrogen-15 and directly bonded hydrogen or carbon-13, and between nitrogen-15 and hydrogen separated by two or more bonds. The data may generally be interpreted in terms of the Fermi contact-coupling mechanism except for those cases where the electron distribution around the nitrogen atom is highly anisotropic. Author

N65-11048# California Inst. of Tech., Pasadena Chemistry and Chemical Engineering Div.
NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY: THE EFFECT OF SOLVENT ON MAGNETIC NON-EQUIVALENCE DUE TO MOLECULAR ASYMMETRY
George M. Whitesides, John J. Grocki, David Holtz, Herbert Steinberg, and John D. Roberts Aug. 1964 29 p refs Submitted for Publication
(Contract Nonr-220(26))
(TR-32; AD-605676)

The chemical shift between the geminal methylene protons of 1-phenylethyl benzyl ether has been measured in a variety of solvents. An approximate correlation observed between solvent dielectric constant and the degree of the magnetic nonequivalence of the methylene protons $\nu_A - \nu_B$ is discussed in light of similar results for structurally related compounds. The variation in $\nu_A - \nu_B$ with solvent may reflect changes in the conformation of the benzylic phenyl ring with respect to the methylene group. Author

N65-11059*# Notre Dame U., Ind.
EFFECT OF IONIZING RADIATION ON A SERIES OF SATURATED POLYESTERS
G. F. D'Alelio, Roland Häberli, and George F. Pezdirtz Washington, NASA, 1964 68 p refs
(NASA-SP-58) OTS Prices: HC $1.75/MF $0.75

The polyesters of dihydric alcohols, HO-R_1-OH, and dicarboxylic acids, HOOC-R_2-COOH, were prepared autocatalytically and underwent ionizing radiation. The observed radiation effects were correlated to the molecular weights of the respective polymers. It was shown that the structural features of the polyester segment derived from the polyesterification of specific diols and specific diacids influenced greatly the direction and magnitude of the radiation effects. G.G.

N65-11092# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J. Exploratory Research Div. S
ELECTRONIC PROPERTIES OF AROMATIC COMPOUNDS
Carol K. Pearce Aug. 1964 25 p refs
(USAEL-TR-2499; AD-607660)

Aromatic compounds are potentially useful for electronic devices. Characteristics basic to an understanding of this group of organic compounds are discussed. Some recent achievements in areas relevant to eventual use of these compounds in electronic devices are presented. Author

N65-11119# Calvin Coll., Grand Rapids, Mich.
SILVER MIGRATION AND TRANSPORT MECHANISM STUDIES IN SILVER OXIDE-ZINC BATTERIES Quarterly Technical Progress Report, 1 Jun.–1 Sep. 1964
T. P. Dirkse [1964] 34 p
(Contract AF 33(615)-1236)
(QTPR-3; AD-605684)

The applicability of Fick's law of diffusion to the diffusion of hydroxide and zincate ions through a cellophane membrane was studied and verified. The effect of surfactants on the type of zinc deposit obtained when zinc is electroplated from a zincate solution was studied over a range of current densities and zincate concentrations. These surfactants were also incorporated in the zinc electrode. A few of these surfactants appear to improve the cycle life characteristics of the zinc electrode. However, when incorporated in the electrolyte they seem to afford no improvement in cycle life at higher current

densities. The decomposition of Ag_2O in KOH solutions was followed and the effect of added materials on this process was noted. Author

N65-11123# Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.

AMINE EXTRACTION-SPECTROGRAPHIC DETERMINATION OF TANTALUM, TITANIUM, TUNGSTEN, AND ZIRCONIUM IN PLUTONIUM

R. Ko Jun. 1964 11 p refs
(Contract AT(45-1)-1350)
(HW-83072)

A 20% solution of tri-n-octylamine in xylene and 6 M HNO_3 was used as the medium in the extraction of Pu(IV) from 10 g/liter plutonium solutions and produced 99% extraction efficiencies. The effects of chloride and fluoride on the extractions of the impurities from tantalum, titanium, tungsten, and zirconium in the aqueous phase were measured in 6 M HNO_3 containing 0.1 to 1 M HCl, and 0.001 to 1 M fluoride, respectively. Tantalum could be extracted in the presence of fluoride or chloride, but titanium, tungsten, and zirconium were extractable only in the chloride concentration. Excellent quantitative recoveries of the undissolved oxides through amine extraction were obtained. After purification procedures, the final residues were dissolved in 0.1 M HF and analyzed spectrographically by graphite spark excitation using niobium as the internal standard. Limits of 50 ppm for tantalum and tungsten, and 5 ppm for titanium and zirconium were found for the amine-extraction spectrographic procedure. G.G.

N65-11142# Dow Chemical Co., Denver, Colo. Rocky Flats Div.

THE DETERMINATION OF TRACE RESIDUES ON METAL SURFACES

J. L. Holst and D. K. Strangfeld 16 Nov. 1964 26 p refs
(Contract AT(29-1)-1106)
(RFP-419)

Analytical methods have been developed to characterize or identify residues removed from metal surfaces. The results are quantitative for several compounds, such as certain hydrocarbons, inorganic chlorides, water, and amine hydrochlorides. Solvents are used directly as surface rinsing agents or for rinsing cold traps used on high vacuum cleaning systems. A method of determining water in halogenated solvents in the near infrared region is also reported. A unique method of drying the reference solvent using a water-solvent equilibrium is described. Author

N65-11143# Dow Chemical Co., Denver, Colo. Rocky Flats Div.

COMPARISON OF SOLVENTS FOR CLEANING METAL SURFACES

D. S. Irwin and T. C. Johnson 23 Nov. 1964 14 p
(Contract AT(29-1)-1106)
(RFP-469)

A solvent testing program was conducted to determine the best solvent for cleaning operations. Trichloroethylene was found to be the most effective cleaning agent of all those that met the requirements. The ultrasonic-vapor degreasing combination cleaning method using trichloroethylene as the solvent was found to be more effective in removing residues from all part types than any of the methods used previously. Author

N65-11148# Weismann Inst. of Science, Rehovoth (Israel)

RESEARCH ON MEASUREMENT OF PRESSURE INDUCED SHIFTS OF ABSORPTION LINES IN THE INFRARED SPECTRUM Annual Summary Report No. 3, 1 Dec. 1962-31 Dec. 1963

J. H. Jaffe May 1964 6 p refs
(Contract AF 61(052)-388)
(AFCRL-64-629; AD-603937)

The pressure-induced shifts in the emission, as well as the absorption of infrared lines, were analyzed by a dynamic theory without the introduction of arbitrary parameters. No differences in shifts between the emission and the absorption lines were predicted. In experimental studies of a diatomic molecule that was perturbed by another diatomic molecule, a shift oscillation, believed to be due to near-resonant dipole interaction, was observed. G.G.

N65-11152# London U. (Gt. Brit.) Royal Holloway Coll.

BORON HALIDES AND DERIVED COMPOUNDS Annual Technical Status Report, 1 Oct. 1962-30 Sep. 1963

Arthur Finch and I. J. Hyams [1963] 29 p refs
(Contract DA-91-591-EUC-2705)
(AD-424127)

Compounds of the general formula B_2X_4 and of alkylene dioxaborolans and alkylene dioxaborinans were investigated. The B_2F_4 was prepared from B_2Cl_4, and a detailed study of its infrared spectrum was made, and is discussed. The infrared spectra of several cyclic molecules were measured, and a linear correlation between their frequencies was found. The kinetics of the liquid-phase pyrolisis of 2-chloro-1,3,2-dioxaborolan was investigated at different temperatures through the disappearance of the easily hydrolyzable chlorine and the appearance of infrared absorption bands of the postulated pyrolysis product $(ClCH_2CH_2OBO)_3$. Some exploratory attempts to synthesize dioxacompounds containing a B–B bond are presented. G.G.

N65-11195# Mound Lab., Miamisburg, Ohio

ISOTOPE SEPARATION DURING FREEZING OF WATER AND DIFFUSION CONSTANTS OF D AND O^{18} IN THE ICE

W. Kuhn and M. Thürkauf 11 Dec. 1964 34 p refs Transl. into ENGLISH from Helv. Chim. Acta (Basel), v. 41, no. 4, 1958 p 938–971
(Contract AT(33)-1-GEN-53)
(MLM-1206(Tr)) OTS: $2.00

On the basis of measured separation parameters and the diffusion coefficients, the possibility of a multiplication of the separation by a hairpin counterflow method in the partial crystallization of water is presented. Using an extensive analogy to the conditions occurring in a rectifying column, the number of separating stages, the throughput, the necessary reflux, the product output, and the startup period of a method based on the multiplication of the separating effect are given, and the equations are applied to the special case of the D_2O separation occurring during the freezing of water. A practical application is considered in the preparation of crystals with a uniform linear dimension of 10^{-4} cm or less and a circulation that can be produced in a hairpin counterflow installation. G.G.

N65-11201# Joint Publications Research Service, Washington, D.C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 123: SEVERAL PHYSICO-CHEMICAL PROBLEMS AFFECTING CERAMIC OXIDES

Yen Tung Sheng 17 Nov. 1964 28 p refs Transl. into ENGLISH from K'ohsueh T'ung Pao (Peking), no. 8, Aug. 1964 p 682–694
(JPRS-27422; TT-64-51672) OTS: $2.00

A series of new silicates with a melting point of above 2000° or even 3000° C were investigated for application in high-temperature and ultrahigh-temperature environments, such as in high-power ultrahigh-frequency electronic tubes and microwave transmission windows. The thermodynamic processes of firing, crystal growth, and second recrystallization of calcium oxide, beryllium oxide, aluminum oxide, as well as various other oxides, were observed. G.G.

N65-11208# Johns Hopkins U., Baltimore, Md. Astrophysics and Physical Meteorology Lab.
LINE WIDTHS AND STRENGTHS IN THE ν_2 WATER BAND Final Report, Oct. 1962–Sep. 1963
Hajime Sakai Jun. 1964 13 p
(Contract CWB-10483)

Some measurements of the absolute strength and the widths of water-vapor lines in the 6-micron absorption band are presented. A modified high-resolution infrared grating spectrometer was empoyed in the spectral analysis, and the humidity was monitored by hygrometers placed inside the spectrometer casing. By application of the slit function correction, the peak absorption value, and the width of the water-vapor lines were determined from the observed spectrometer results. The strength value was extrapolated from the known values of the water-vapor concentration. G.G.

N65-11211# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
POLYMERIZATION KINETICS BY MEANS OF DIFFERENTIAL THERMAL ANALYSIS. PART II: DERIVATION OF RATE AND ENTHALPY EQUATIONS Technical Documentary Report, Nov. 1962–Nov. 1963
W. E. Gibbs, K. R. Fisch, M. Gehatia, and I. J. Goldfarb Jul. 1964 18 p refs
(ML-TDR-64-136; AD-606560)

Rate equations and enthalpic parameters were derived for use in differential thermal analysis (DTA) of polymerization reactions. General free-radical polymerization kinetics are discussed, and the existence of a "stationary state" under DTA conditions was demonstrated by comparison of a theoretical computer curve, based on stationary state assumption, with actual experimental conditions. These curves appear to be almost superimposable. Author

N65-11220# London U. (Gt. Brit.) King's Coll.
INFLUENCE OF IONIC SOLUTES UPON RELAXATION TIMES
V. Gold Jul. 1964 96 p refs
(Contract AF 61(052)-458)
(AFOSR-64-1605; AD-605723)

Spin-lattice relaxation times (T_1) have been measured by the "direct" NMR method for dilute aqueous solutions of Ni(II) in presence of cyanide, halide, ions, acetone, t-butyl alcohol, trimethyl phosphate, edta, and trien, for some of these solutes in the absence of paramagnetic ions. Spin-spin relaxation times (T_2) have been used to measure the influence of hydrogen ions on complex formation between water and acetaldehyde or pyruvic acid. Complex formation, between methanol and other solvents through hydrogen-bonding, has been investigated by measurements of chemical shifts, the influence of methoxide ions on multiplet collapse, and by indicator measurements. Author

N65-11230# Bureau of Mines, Boulder City, Nev. Boulder City Metallurgy Research Lab.
REACTIONS BETWEEN MANGANOUS OXIDE, GRAPHITE, AND MANGANESE CARBIDE
Eben L. Singleton, A. E. Morris, and R. V. Lundquist 1964 26 p refs
(BM-RI-6567)

This experimental research was performed to determine rate-of-reaction constants on the MnO-C and Mn_7C_3-3MnO systems at 1100°, 1150°, and 1185° C. Reactions were conducted at atmospheric pressure under controlled flow of purified helium through the furnace chamber. The weight-loss method defined reduction percentages, and reaction products were identified by X-ray methods. The system MnO-C followed a linear reaction rate, and experimental results produced an apparent activation energy of 55.8 kcal per mole of MnO. The system Mn_7C_3-3MnO followed a parabolic rate of reaction law, and yielded an apparent activation energy of 114.4 kcal per mole for the reaction. Author

N65-11251# Aberdeen Proving Ground, Md. Coating and Chemical Lab.
APPLICATION OF INTERNAL-STANDARD PYROLYTIC GLC TO THE SEMIQUANTITATIVE ANALYSIS OF ORGANIC COATINGS
George G. Esposito 2 Jun. 1964 16 p refs
(CCL-164; AD-447225)

The primary objective of this investigation was to demonstrate the applicability of the internal standardization technique used with pyrolytic gas chromatography, for quantitative purposes, to the analysis of some coating materials. The technique and its accuracy are described and illustrated by application to the semiquantitative determination of some polymethacrylates and polystyrene in various coating systems, and comparison is made to the "total area" method. Author

N65-11252# Bureau of Mines, College Park, Md. College Park Metallurgy Research Center
EVALUATION OF A COMBINED ION EXCHANGE X-RAY SPECTROGRAPHIC METHOD FOR DETERMINING TRACE METALS IN TUNGSTEN
Ernest F. Spano, T. E. Green, and W. J. Campbell 1964 20 p refs
(BM-RI-6565)

A combined ion exchange X-ray spectrographic method was evaluated for the determination of 11 metallic elements in high-purity tungsten: Aluminum, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, titanium, and zinc. Copper, nickel, and manganese in the 5μg to 100μg range (1 to 20 parts per million based on 5-gram samples of tungsten), calcium in the 10μg to 100μg range, and cobalt in the 5μg to 20μg range can be determined within an accuracy of ±10% of the amount present. Limits of detection of these elements are 0.05μg to 0.14μg. The overall method was unsatisfactory for the determination of aluminum, chromium, iron, magnesium, titanium, and zinc in tungsten. Author

N65-11259# Boeing Co., Seattle, Wash.
REVIEW OF REACTION KINETICS OF HIGH TEMPERATURE AIR
Tzy Cheng Pong and A. L. Pindroh 6 Mar. 1963 84 p refs
(D2-13422, Rev. A; AD-444645)

A detailed review was made of the rates of the chemical reactions for which both the reactants and products are in the gaseous state. Some theoretical background based on

the principles of the molecular theory of gases is provided. Various existing theories for reaction rates, from the Arrhenius equation in 1889 to the more recent quantum-mechanical methods, are discussed. Also discussed in detail are the techniques for measuring the reaction rates of specific reactions, from the use of the high-temperature furnace and chemical titration to the shock-tube experiments with spectroscopic observation. A substantial amount of data on rate constants is presented in tabular form, especially for those reactions between the major constituents of air. Author

N65-11282# Wisconsin U., Madison Theoretical Chemistry Inst.
VARIATIONAL SOLUTIONS TO THE BRILLOUIN-WIGNER PERTURBATION DIFFERENTIAL EQUATIONS
William J. Meath 14 Nov. 1963 20 p refs
(Contract AF 33(657)-7311)
(WIS-TCI-35; AD-424633)

The usual Brillouin–Wigner (BW) perturbation theory series' expansions for the energy and wave function of a perturbed system are replaced by a set of perturbation differential equations. Thus, it seems probable that many of the developments of Rayleigh–Schrödinger (RS) perturbation theory that depend largely on the RS perturbation differential equations should carry over to BW theory. A variational method, analogous to the Hylleraas principle in RS theory, is derived that can be used to obtain approximate solutions to the nth order BW perturbation equation for systems in the lowest energy state of a given symmetry. The BW energy to (2n)th order obtained in this manner is an upper bound to the exact BW energy to (2n)th order if the (n–1)th order wave function is known exactly. This of course is usually true for n = 1 only. It is shown, however, that these variational techniques give an upper bound to the total energy, even if the (n–1)th order BW wave function is unknown. Finally, a convenient matrix method of applying the variational principles is suggested, and a method of using this formulation of BW perturbation theory is discussed formally. Author

N65-11285# Cornell U., Ithaca, N.Y.
AN ELECTRIC FIELD EFFECT ON THE CRITICAL OPALESCENCE
P. Debye and K. Kleboth 15 Sep. 1964 30 p refs
(Contract NR-401(17))
(TR-9; AD-604494)

The free energy involved in the concentration fluctuations of a liquid mixture is changed by an electric field. The effect becomes observable near the critical point. It increases with decreasing distance from the critical temperature, and it is proportional to the square of the field intensity and to the second derivative of the dielectric constant with respect to the concentration. The effect can be interpreted as a shift of the critical temperature. Experiments performed with a field intensity of 45 000 V/cm on the system nitrobenzene-2,2,4-trimethyl pentane give a value of 0.015° for this shift, while the theory predicts 0.010°. Also in good agreement with the theory is the dependence on the field intensity and on the temperature distance from the critical temperature. Author

N65-11291# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile & Space Systems Div.
THE BONDING REACTION MECHANISM IN CHEMICALLY BONDED ZrO_2. PHASE II Interim Report
V. Edlin 10 Aug. 1964 22 p refs
(SM-45974)

This report describes the work performed in the program to obtain an understanding of the chemical reactions and bond mechanism involved in the low temperature, 400° F (205° C), bonding of zirconia (ZrO_2). Chemical-bond phenomena were investigated by means of petrographic analysis and stoichiometric studies. This phase of the investigation led to the determination of the chemical reactions occurring for ZrO_2 bonded with monofluorophosphoric acid (H_2PO_3F). The bonding reaction is produced by the formation of zirconium tetrafluoride (ZrF_4) and subsequent reaction with a phosphate radical to form the bonding medium zirconium pyrophosphate (ZrP_2O_7). It has been determined that ZrP_2O_7 produced without the presence of the fluoride ion is a relatively weak bonding medium for ZrO_2. Chemical bonding of magnesia (MgO) at the same temperature, based upon bonding reactions similar to those employed with ZrO_2, produced apparently strong bodies of MgO. Author

N65-11295# Akron U., Ohio Inst. of Rubber Research
MOLECULAR STRUCTURE AND PHYSICAL BEHAVIOR OF POLYMERS Technical Documentary Report, 1 Feb.–31 Dec. 1963
P. Dreyfuss, A. N. Gent, N. N. -C. Hsu, and V. V. Vickroy Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 47 p refs
(Contract AF 33(657)-10868)
(ML-TDR-64-19; AD-605377)

Eleven model copolymers were prepared, and their crystallization behavior was studied. They crystallized at all compositions, the equilibrium melting temperatures showing a characteristic eutectic effect. The crystallization followed simple Avrami kinetics, with the rate depending primarily on the degree of supercooling. The amount of crystallinity varied with temperature in a complex manner. Cross-linked and uncross-linked samples of *trans* 1,4 polyisoprene have been studied dilatometrically. The melting temperatures of both the α and β crystal forms were decreased by crosslinking, by about equal amounts. The rates of crystallization were also markedly decreased, roughly in accord with the reduced melting temperatures. The elastic behavior of cross-linked polyethylene was examined. A value of 3200 is deduced for the molecular weight between entanglements, and 6.2 cross links/100 eV for the cross-linking efficiency. Author

N65-11296# Union Carbide Research Inst., Tarrytown, N.Y.
FLUORINE OXIDIZERS Quarterly Technical Summary Report, 1 Jun.–1 Sep. 1964
R. H. Toeniskoetter and F. P. Gortsema [1964] 23 p refs
(Contract DA-31-124-ARO(D)-77; ARPA Order 402)
(QTSR-5; AD-447573)

Chloryl fluoride reacts with cesium fluoride at 0° to 25° to produce a solid having a limiting composition near CsF_2. The solid, however, possesses little oxidizing strength. Reaction of chloryl fluoride with cesium oxide gives a solid product containing cesium, fluorine, and chlorine in variable composition. Chloryl fluoride and chlorine trifluoride react with cesium azide with formation of fluorine-containing solids. These reactions are being studied as possible routes to fluorine–nitrogen anions. The reaction of potassium perchlorate with bromine trifluoride gives nearly quantitative yields of chloryl fluoride and only minor amounts of perchloryl fluoride. Platinum hexafluoride and chlorine trifluoride react to form chlorine pentafluoride and the solid compound ClF_3·PtF_5. Thermal decomposition of this substance produces fluorine, chlorine trifluoride, and platinum tetrafluoride. Author

N65-11313# Monsanto Research Corp., Dayton, Ohio
GAS-LIQUID CHROMATOGRAPHIC FRACTION COLLECTING AIDS AND ANALYSIS OF ALKYL BROMIDES Technical Documentary Report, Jul. 1963–Mar. 1964
William D. Ross, Richard L. Evers, James F. Moon, and J. E. Katon Wright-Patterson AFB, Ohio. AF Mater. Lab., Jul. 1964 22 p refs
(Contract AF 33(616)-8465)
(ML-TDR-64-188; AD-605379)

Three modifications for improvement of fraction collection of eluates from the gas chromatograph have been designed and built in the laboratory. They include an electrostatic precipitator, a heated chromatograph outlet, and a specialized glass fraction collector for transfer to liquid eluates to infrared cells. Drawings, schematics, and an evaluation of data are given. A gas chromatographic technique has been developed for the analysis of 16 alkyl bromides. Chromatograms and graphs are shown. Author

N65-11319# Rensselaer Polytechnic Inst., Troy, N.Y.
MOLTEN SALT DATA: ELECTRICAL CONDUCTANCE, DENSITY, AND VISCOSITY
George J. Janz, Anthony T. Ward, and Roger D. Reeves Jul. 1964 185 p refs Submitted for Publication
(Grant AF-AFOSOR-181-63)
(AFOSR-64-0039; AD-605938)

Conductance, density, and viscosity data at round values of temperature (° K) are given for some 126 inorganic compounds as single-salt melts (fluorides, 15; chlorides, 34; bromides, 20; iodides, 23; oxides, 7; sulphates, 5; nitrates, 7; carbonates, 3; and miscellaneous, 12). Equations expressing the temperature dependence of these properties for the single-salt melts are also given. For mixtures of these salts, the binary systems that have received attention are listed; numerical values for these mixtures are not given but are referenced. Author

N65-11323# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
THE PREPARATION OF PURE BERYLLIUM OXIDE BY SOLVENT EXTRACTION WITH ACETYLACETONE IN THE PRESENCE OF ETHYLENEDIAMINE TETRAACETIC ACID, PROCEDURE AND CHEMISTRY
C. E. L. Bamberger, H. F. Mc Duffie, and C. F. Baes, Jr. Nov. 1964 49 p refs
(Contract W-7405-ENG-26)
(ORNL-3733) OTS: $3.00

A procedure for the preparation of high-purity beryllium hydroxide has been demonstrated on a kilogram scale, and systematic study of its chemistry has been completed. The starting material, $Be(OH)_2$, is dissolved in a CCl_4 solution of acetylacetone, HX, to form the chelate BeX_2. Metallic impurities are removed by extraction with aqueous HNO_3, and beryllium hydroxide is precipitated with ammonia. The original procedure was modified to include removal of HX from the HNO_3–$Be(NO_3)_2$ strip solution by chloroform scrubbing and precipitation of beryllium in the presence of EDTA with gaseous ammonia at 75° C. The product was a granular, easily dried, free-flowing powder having approximately the composition $Be(OH)_2 \cdot 0.3H_2O$. Ignition of the product, 4 kg of which was prepared in 85% yield in 1-kg batches in all-plastic bench-scale equipment, gave BeO in which the total of measureable metallic impurities was <5 ppm. Author

N65-11326# Air Reduction Co., Inc., Murray Hill, N.J. Central Research Labs.
RESEARCH ON APPLICATIONS OF KRYPTON-85 AND OTHER RADIOACTIVE ISOTOPES Final Report
Arthur M. Feibush Sep. 1964 71 p refs
(Contract AT(30-1)-2906)
(NYO-2906-1) OTS: $1.75

Methods for utilizing krypton-85 as a radiation source have been developed and successfully applied to a number of polymerization and graft copolymerization reactions. Alpha and beta emitters in concentrations up to 42 microcuries per square foot of heat transfer surface did not enhance nucleation in nucleate boiling regimes in a boiling liquid system. A useful method was developed for direct comparison of the efficiency of two heat transfer surfaces in a boiling liquid. Some trans-polyacetylene has been produced by the irradiation of gaseous acetylene. Oxygen must be rigorously excluded in order to obtain the homopolymer. Unsaturated hydrocarbon gases irradiated in the presence of oxygen formed a highly oxygenated polymer. No homopolymer was formed. This novel oxidation–polymerization reaction was studied with five hydrocarbons. The properties of the polymers were independent of the reaction conditions and the starting hydrocarbon. Author

N65-11329# Mound Lab., Miamisburg, Ohio
A CRYOGENIC PROCESS FOR PURIFYING HELIUM-3
E. W. Wiederhold and B. D. Scearce 13 Nov. 1964 13 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1201) OTS: $1.00

A cryogenic process was developed for removing gaseous impurities, except helium-4, from previously enriched helium-3. Vapor pressure versus temperature considerations indicated that less than 10^{-15} mole % tritium gas would remain in equilibrium with its solid phase at 4.2° K in 1 atm of helium-3. Therefore, a cold trap was designed to freeze tritium and other gaseous impurities (except helium-4) from helium-3 at the boiling point of helium-4 (4.2° K). Helium-3 (bp 3.2° K), which had been purified by thermal diffusion to about 10^{-8} mole % tritium and more than 99 mole % total helium, was fed to the freeze-out chamber at a rate of 1 liter/min. The chamber, cooled by a liquid helium-4 bath, was a 122 cm^3 copper pot loosely packed with silica gel to provide a large contact area for the feed gas. Low-level counting and mass-spectrometer analyses showed that the product contained about 10^{-11} mole % tritium and less than 0.1 mole % total impurities. Author

N65-11358# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
THEORETICAL STUDIES ON THE THERMAL DEGRADATION OF LADDER POLYMERS Technical Documentary Report, Jan.–Dec. 1963
Martin M. Tessler Jul. 1964 58 p refs
(ML-TDR-64-151; AD-606065)

The random thermal degradation of four- and six-membered ring ladder polymers was investigated, and results were compared to a single chain polymer undergoing degradation under the identical conditions. The change in molecular weight versus time was plotted, and significant differences were found in the shapes of the curves. Similar studies were conducted with imperfect ladder polymers that had single bonds along the backbone of the polymer. Author

N65-11366# London U. (Gt. Brit.) Royal Holloway Coll.
VERY LOW-FREQUENCY INFRA-RED SPECTROSCOPY Annual Technical Status Report No. 2, 1 Oct. 1962–1 Oct. 1963
Arthur Finch and D. Steele [1963] 8 p refs
(Contract N-62558-3030)
(AD-424897)

Infrared spectroscopy at very low frequencies was used to observe the spectra of several solids, which were dispersed in polythene welding powder and pressed into a disc form at 120° C at 7 atmospheres. The spectra of the following compounds were observed: various phosphorus iodides, calcium dicyanamide, perfluorobiphenyl, various tin halides, and azulene. A detailed analysis of the specific spectra requires vibrational computations, and a computer program in autocode language has been written for this purpose, and will be used with the "Ferranti" computer for the Atlas and Mercury programs. G.G.

N65-11377 Naval Scientific Technical Information Center, London (Gt. Brit.)

THE USE OF SILICON ORGANIC COMPOUNDS TO IMPROVE THE PROPERTIES OF GLASS

S. I. Silvestrovitch and I. A. Boguslavski Jun. 1964 14 p refs Transl. into ENGLISH from Steklo i Keram. (Moscow), v. 17, no. 1, 1960 p 7–12
(NSTIC Transl.-1523; AD-445151)

Experiments are reported to study the physicochemical properties of glass that had been treated under given conditions with silicon organic compounds. Properties examined included hydrophobic properties, chemical inertness, thermal stability, and mechanical strength. Conditions of treatment, preparation methods for the glass specimens, solutions for treating the specimens, and testing methods are specified, and results are reported. D.E.W.

N65-11386# Dow Chemical Co., Midland, Mich. Thermal Research Lab.

JANAF THERMOCHEMICAL TABLES

D. R. Stull, J. Chao, T. E. Dergazarian, L. A. Du Plessis, B. H. Justice et al Jul. 1964 127 p
(Contract AF 04(611)-7554)
(AD-446385)

This paper contains tables of the thermodynamic properties of propellant combustion products for use by the aerospace industry. The thermodynamic functions of each table have been fitted by a seven-constant equation for computational purposes, and the constants $L_i(i = 1,2,\text{---}7)$, which are sufficient to determine all the tabulated functions, have been calculated. G.G.

N65-11393# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.

DEVELOPMENT OF NONFLAMMABLE HYDRAULIC FLUIDS AND LUBRICANTS Bimonthly Progress Report, Jun. 18–Aug. 17, 1964

E. H. Kober, H. F. Lederle, and G. F. Ottmann 28 Aug. 1964 26 p refs
(Contract NObs-90092)
(BMPR-5; AD-604490)

A new type of water-soluble phosphonitrilates for potential use as water-base hydraulic fluids was synthesized by the reaction of trimeric bis(p-hydroxyphenyl) phosphonitrilate with ethylene oxide. Trimeric and tetrameric bis-(p-nitrophenyl) phosphonitrilate, a trimeric bis(m-nitrophenyl-2,2,2-trifluoroethyl) phosphonitrilate, and tetrameric bis(p-hydroxyphenyl) phosphonitrilate were synthesized as intermediates to be used in the preparation of potential water-base hydraulic fluids. Hexakis (3-pyridinyl) triphosphonitrilate was synthesized and found to be water insoluble. The chloromethylation of hexaphenyl triphosphonitrilate has finally been effected employing chloromethyl methyl ether as chloromethylating agent. Several new arylamino-polyfluoroalkoxy phosphonitriles have been isolated and characterized. Two trimeric and two tetrameric mixed substituted aryl-polyfluoro alkyl phosphonitrilates performed very satisfactorily in Falex wear tests. Author

N65-11400# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.

NUCLEAR MAGNETIC RESONANCE STUDIES ON THE HINDERED ROTATION IN DIMETHYLFORMAMIDE: SOLVENT EFFECT

A. Greenville Whittaker and Seymour Siegel 10 Sep. 1964 20 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-165; TDR-469(5250-30)-1; AD-450030)

A number of chemical shift measurements were made on dimethylformamide (DMF) as a pure liquid and in the solvents carbon tetrachloride, acetone-d_6, fluorotrichloromethane, and hexamethyldisiloxane. These measurements included the temperature dependence of the methyl doublet separation; the effect of solvent and concentration on the methyl doublet separation; and the effect of temperature, solvent, and concentration on the chemical shift of the formyl proton resonance and on the center of the methyl doublet. The results show large solvent effects that are interpreted in terms of dipolar association between DMF and the solvent. No evidence for hydrogen-bonded species was found. Activation energies for the barrier to hindered rotation were calculated and were found to depend strongly on the nature of the solvent. Author

N65-11404*# California U., Berkeley

THE INFLUENCE OF ELECTRODE REACTION KINETICS ON THE POLARIZATION OF FLOODED POROUS ELECTRODES

E. A. Grens, II and C. W. Tobias [1964] 27 p refs
(Grant NsG-150-61)
(NASA-CR-59573) OTS Prices: HC $2.00/MF $0.50

Using a recently developed numerical techniques for calculating the polarization curves for flooded porous electrodes, the effects of parameter values in a Volmer-type kinetic expression are examined, including the use of linear and Tafel approximations to this expression. These approximations were found to result often in spurious predictions of polarization behavior. Further, assumptions of uniformity of electrolyte concentration in a porous electrode at steady state can yield significantly low calculated overpotentials. These results indicate the necessity for individual examination of each case of interest and for avoiding simplified rules for deriving polarization of a porous electrode in terms of an equivalent flat plate. M.P.G

N65-11417# Army Chemical Center, Edgewood, Md. Nuclear Defense Lab.

LET AND CONCENTRATION EFFECTS IN THE NEUTRON AND GAMMA RADIOLYSIS OF THE SYSTEM TRICHLOROETHYLENE-OXYGEN-WATER

Ronald Sasse Oct. 1964 69 p refs
(NDL-TR-50; AD-441177)

The gamma and neutron radiolysis of aqueous trichloroethylene (TCE) was investigated. Yield of H^+ was determined by dynamic measurement of electrical conductivity. Yields of other products (Cl^-, H_2O_2, H_2, CO_2, CO, and HCOCOOH) were quantitatively determined by various analytical techniques. The $G(H^+)$ is virtually constant at doses up to 400 rads, but decreases gradually at higher doses. The $G(Cl^-)$ is generally equal to $G(H^+)$. The $G(H^+)$ increases with increasing oxygen concentration, increasing TCE concentration, and decreasing

linear energy transfer (LET). The maximum value observed was 126. The $G(CO_2)$, G(CO), and G(HCOCOOH) were smaller by factors of 5 to 10. The $G(H_2)$ and $G(H_2O_2)$ were indistinguishable from those observed in pure water. The system was found to be stable under storage for 9 months. A discussion is presented of the possible significance of the LET dependence of product yield with respect to biological dosimetry. Author

N65-11426# Parametrics, Inc., Waltham, Mass.
USE OF KRYPTONATES IN MATERIALS RESEARCH Quarterly Progress Report
30 Sep. 1964 23 p refs
(Contract AF 33(615)-1268)
(AD-450446)

The validity of the Kryptonate technique and the lack of significant delay in Kr^{85} release caused by the presence of an oxide film was demonstrated. Experiments were performed in static systems wherein the decrease in oxygen pressure was measured as oxidation of the tantalum sample proceeded. Simultaneous measurement of either sample activity or released gas-phase Kr^{85} activity showed that changes in the rate of pressure decrease were also indicated by changes in the rate of release of sample activity. Unexpected high sample activity losses at temperatures above 800° C and low oxygen pressures appear to indicate the formation of lower tantalum oxides than Ta_2O_5. Current efforts are directed towards developing procedures for oxidation kinetics at temperatures in excess of 1000° C. Author

N65-11432# Aeronutronic, Newport Beach, Calif. Research Labs.
INVESTIGATION OF THERMODYNAMIC PROPERTIES OF ROCKET COMBUSTION PRODUCTS Sixth Quarterly Technical Report, 1 Jun.–31 Aug. 1964
D. L. Hildenbrand, L. P. Theard, and F. Ju 1 Oct. 1964 24 p refs
(Contracts AF 04(611)-8523; NOw-61-0905-c; ARPA Order 348-62)
(AFRPL-TR-64-150; U-2837; AD-450219)

This progress report pertains to the investigation of thermodynamic data of the gaseous species in the Be-O, Be-O-H, Be-F, and BeCl systems. The measurements of the vapor pressure of crystalline beryllium were being made by torsion–effusion and torsion–Langmuir methods in order to obtain a more accurate value for the heat of sublimation. Preliminary effusion vapor pressures were obtained with tantalum, molybdenum, and tungsten cells in the range of 1350° to 1530° K. The pumping system on the Knudsen cell compartment of a mass spectrometer has been redesigned in preparation for work on beam-chopping techniques. G.G.

N65-11478# Isomet Corp., Palisades Park, N.J. Chemistry Research Div.
PREPARATION OF NON-STOICHIOMETRIC TUNGSTEN DIOXIDE Technical Documentary Report, Jun. 1962–Mar. 1964
Joseph Malgiolio and Horace W. Chandler May 1964 33 p refs
(Contract AF 33(657)-9159)
(ML-TDR-64-149; AD-606418)

Nonstoichiometric WO_2 was prepared by the solid-solid reaction of W and WO_3. Four different compositions, $WO_{1.94}$, $WO_{1.97}$, $WO_{2.00}$, and $WO_{2.02}$ within the range of homogeneity of WO_2 were prepared in this way. The presence of other phases consisting of W, $WO_{2.72}$, and $WO_{2.90}$, WO_3 was detected by X-ray techniques with the limits of detection being W, 0.1% to 0.2%; $WO_{2.72}$, 3%; $WO_{2.90}$, 2%; WO_3, 0.4 to 0.5%. The limits of homogeneity of WO_2 were found to be $WO_{1.940}$ and $WO_{2.025}$. Samples of WO_2 having the four above-mentioned compositions were also prepared to contain 2.4% O^{18}. Samples containing W^{185} were prepared by thermal neutron irradiation of WO_2. Author

N65-11557# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEW METHODS OF INORGANIC SYNTHESIS
V. I. Mikheyeva 25 Mar. 1964 13 p refs Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 5, 1963 p 34–39
(FTD-MT-64-96; AD-605864)

This paper discusses the chemical nature and the properties of hydrides of various compositions as bases for hydrogenation catalysts. Because of the nonreversible character and the many possible directions of the reactions of these nonmetals and their compounds, a special emphasis was placed on the concentration of the parent substances, the temperature, the pressure, and the application of neutral, as well as chemically active, solvents. Recommended is also the study of the hydride crystals and their molecular structure by X-ray and mass spectroscopy, gas chromatography, and electronography. G.G.

N65-11584# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STUDY OF ELECTROPHORETIC MOBILITY OF COLLOIDAL PARTICLES BY METHOD OF DISLOCATION OF BOUNDARIES
Arvind Kumar and Abani K. Bhattacharya 30 Mar. 1964 9 p refs Transl. into ENGLISH from Kolloid. Zh. (Moscow), v. 25, no. 3, 1963 p 329–333
(FTD-MT-63-263; AD-605909)

The electrophoresis of sol $Fe(OH)_3$ at various stages of dialysis was studied, employing as an auxiliary liquid various chlorides with monovalent and bivalent cations, and with an electrical conductivity equal to the electrical conductivity of the sol. It was found that the maximum electrophoretic mobility and the specific electrical conductivity corresponded to the critical coagulation concentration. G.G.

N65-11619# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MECHANISM OF DIRECT ACTION OF RADIATION ON PERCHLORIC U.C. ACID
L. T. Bugayenko 28 Jan. 1964 9 p refs Transl. into ENGLISH from Tr. II Vsesoyuznogo Soveshchaniya po Radiatsionnoy Khim., Izd. Akad. Nauk SSSR, (Moscow), 1962 p 144–148
(FTD-MT-63-194; AD-602600)

The continued investigation of the mechanism of radiation-induced transformation of perchlorate ions is reported, particularly the influence of ions of bivalent iron and molecules of organic compounds (ethyl alcohol and acetone) on the reduction of perchlorate ion and yields of perchlorate ion-reduction products. In using X-rays with 70-kV maximum energy, it was found that in oxygen-saturated solutions of iron perchlorate in 2.5-M $HClO_4$, the yield of perchlorate ion reduction in the range of Fe^{2+} ion concentration 0.005 to 0.06 M maintains a constant value of 1.20 ±0.05 ions per 100 eV of absorbed energy, whereas the yields of chlorate and chloride ions depend on Fe^{2+} ion concentration. Irradiation of solutions of ethyl alcohol and acetone in 2.5-M $HClO_4$ led to a decrease in the yields of perchlorate ion reduction that was greater the higher the concentration of organic compound. These results are interpreted in a series of intermediate steps describing the mechanism of direct action of radiation. M.P.G.

N65-11628# Rutgers U., New Brunswick, N.J. School of Chemistry
SORPTION OF HYDROGEN BY GLASSES AND CERAMICS Quarterly Progress Report No. 2, 1 May–31 Jul. 1963
M. J. D. Low 10 Aug. 1963 23 p refs
(Contract DA-36-039-AMC-02170(E))
(Rept.-2; AD-424539)

The construction of continuously variable light attenuators is described. The double beams of the spectrometers were balanced by etching wire screens. Experimental work was started on the sorption of hydrogen on BeO. It is suggested that some activation procedure is necessary; apparently, the oxide must be treated with H_2 and degassed at high temperature in order to be able to sorb H_2. Sorption of H_2 occurred at 300° C, but was not observed below that temperature. If an electrodeless discharge made by a Tesla coil was caused in the gas, some H_2 uptake occurred. R.L.K.

N65-11641# Bologna U. (Italy) Inst. of the Science of Metals and Metallurgy
RESEARCH INTO THE CHEMICAL BEHAVIOR OF SURFACE OF SINGLE- AND BI-CRYSTALS UNDER DIFFERENT EXPERIMENTAL CONDITIONS Quarterly Technical Status Report, 1 May–30 Jul. 1964
Paolo Spinedi [1964] 16 p
(Contract DA-91-591-EUC-3202)
(QTSR-2; AD-605867)

This report places emphasis on some results of decorating tests carried out with organic substances, as well as on the chemical and electrochemical behavior of zinc tricrystal surfaces toward an adequately moderated etchant. Typical kinematographic sequences of displacement and decorating reactions on the surface of a zinc tricrystal are presented. G.G.

N65-11646# FMC Corp., Princeton, N.J. Chemical Research and Development Center
QM ELASTOMER CONTRACT Progress Report III, 27 Dec. 1963–26 Mar. 1964
J. A. Gannon, C. A. Erickson, and E. W. Cook 15 Apr. 1964 40 p refs
(Contract DA-19-129-AMC-147(N))
(PCR-372; AD-606286)

Initial copolymerization studies of the thermal cycloaddition reaction of $[CF_2=CFCH_2CH_2Si(CH_3)_2]_2O$ with $CF_2=CFCF_2CFClCF_2CF=CF_2$ resulted in the formation of mixtures of low molecular weight products. In another approach, work has been started on the inclusion of novel fluoroolefinic monomers in a vinylidene fluoride/hexafluoropropylene emulsion polymerization system. The monomer synthesis portion of the program has been accelerated and there are now in hand or in process, adequate supplies of the above disiloxane and heptadiene for a sustained polymerization study. In addition, syntheses of additional monomers; 3, 3, 4, 4-tetrafluorohexadiene-1, 5; 2, 2, 3, -tri(trifluoromethyl) perfluorooxetane; 2, 2, 3, 4-tetra(trifluoromethyl) perfluorooxetane and bis(2-(2', 3', 3'-trifluorocyclo-1'-butenyl) ethyl dimethyl siloxane) have been completed, or are in advanced stages of progress. Author

N65-11691# Sandia Corp., Albuquerque, N. Mex.
NONELECTROSTATIC SOLVENT EFFECTS IN CHEMICAL KINETICS
James O. Wear Nov. 1964 30 p refs
(SC-RR-64-1256) OTS: $2.00

The nonelectrostatic solvent effects have been studied extensively by comparison of data and theory. Unless there are specific solvent effects, it has been shown that for a reaction that can be studied in both the gas phase and the liquid phase, the solvent affects the reaction only slightly. Solvents such as carbon tetrachloride have been found, generally, to give the same rates as observed in the gas phase. The predictions of absolute rate theory for solvent effect have been examined, and it has been observed that the relation

$$k(\text{solution})/k(\text{gas}) = {}_e\Sigma\sigma/RT$$

fits the data best. For reactions that take place only in solution, various nonelectrostatic effects have been studied. The effect of viscosity has been found to be fairly valid. Both the solvation effects, when separable from other effects, and the cage effect, particularly as it applies to photochemical reactions, are discussed. Author

N65-11722# Oak Ridge National Lab., Tenn. Analytical Chemistry Div.
EQUILIBRIUM DISTRIBUTION OF METAL-ION COMPLEXES
Gerald Goldstein Nov. 1964 51 p refs
(Contract W-7405-ENG-26)
(ORNL-3620) OTS: $3.00

Data for the formation of metal complexes with inorganic ligands are being compiled as distribution diagrams (fraction of each species present vs ligand concentration). The necessary computation and plotting were done by the CDC-1604 computer. This report contains 138 diagrams for metal complexes with fluoride, chloride, bromide, iodide, ammonia, sulfate, nitrate, thiocyanate, thiosulfate, and cyanide. Diagrams have been made only for those cases in which at least three species were present. Plots have also been made for the dissociation of some common polyprotic acids (species present as a function of pH). Author

N65-11771# Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
IMPROVED GRAPHITE MATERIALS FOR HIGH-TEMPERATURE AEROSPACE USE. VOLUME I: RESEARCH AND DEVELOPMENT FOR IMPROVED GRAPHITE MATERIALS Technical Documentary Report, 1 May 1963–31 Mar. 1964
Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 160 p refs
(Contract AF 33(657)-11171)
(ML-TDR-64-125, Vol. I; AD-608071)

Progress is reported on the basic studies of the carbonization mechanisms of model aromatic compounds. The survey of the thermal reactivity of model compounds continued with the examination by differential thermal analysis of 63 additional substituted aromatics and heterocyclics. The pyrolysis behavior of two different pitches was examined in a thermogravimetric apparatus. Electron spin resonance spectra were obtained under conditions of high resolution for solutions of acenaphthylene in m-quinquephenyl. Nuclear magnetic resonance measurements are reported for some aromatic ions, aromatic pyrolysis products, and complex raw materials for graphite. The thermal decomposition of organic diazocompounds was investigated as an example of a pyrolysis reaction involving radical intermediates but yielding stable diamagnetic products. X-ray data have been obtained for the [002] semilattice spacing in graphite prepared from pure aromatic hydrocarbons and from complex raw materials. Author

N65-11789# Pennsylvania State U., University Park. Materials Research Lab.
THERMODYNAMICS AND KINETICS OF THE DEHYDROXYLATION OF HYDROUS MINERALS Scientific Report No. 1
G. W. Brindley and Rustum Roy Aug. 1964 122 p refs
(Contract AF 19(628)-2773)
(AFCRL-64-817; AD-607879)

In order to design facilities for the thermal extraction of water from possible hydrous minerals on the moon, information concerning the pressure–temperature dehydration curves, the enthalpies of reaction, and the reaction kinetics is necessary so that optimum values can be chosen for such variables as the geometry and size of the furnace, the time, temperature, and pressure of water vapor for dehydration, and the particle size of the hydrous mineral or rock. Using thermogravimetry at low pressures of water vapor, and differential thermal analysis at water-vapor pressures ranging from 15 psi to 10000 psi, the thermodynamics and kinetics of water extraction from serpentine, brucite, kaolinite, dickite, and halloysite have been studied. Author

N65-11800# Technische Hochschule in Graz (Austria)
STUDIES OF PREPARATION AND PROPERTIES OF ACTIVE ALKALI AZIDES AND BARIUM AZIDE AND EFFECTS OF THIS ACTIVITY ON THERMODYNAMIC AND THERMOCHEMICAL DATA
Karl Torkar 13 Aug. 1964 5 p ref
(Contract DA-91-591-EUC-2835)
(AD-420326)

By means of acetone, anhydric barium azide was recrystallized from the nonaqueous solvents dimethyl-sulfoxide and dimethyl formamide. It crystallized in square needles of trapezoidal cross section, with mostly roof-shaped ends, and with a length of up to 2 cm. The radiographic examination of these crystals is described. R.L.K.

N65-11805# Stanford Research Inst., Menlo Park, Calif.
DIFFUSION AND HETEROGENEOUS REACTION. VI: SURFACE RECOMBINATION IN THE PRESENCE OF DISTRIBUTED ATOM SOURCES
Henry Wise, Clarence M. Ablow, and Kenneth M. Sancier Aug. 1964 20 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(SRI-19-P; AD-604108)

A theoretical analysis is made of the simultaneous removal of atoms by a first-order, heterogeneous reaction and their generation by a second-order, gas-phase reaction. Such a model is found applicable to a system in which hydrogen atoms recombine on the walls of a cylindrical vessel in the presence of hydroxyl radicals that may interact in the gas by reaction with hydrogen molecules. The perturbation of the hydrogen-atom concentration profile in the cylinder due to OH as measured by electron spin resonance spectroscopy is employed to calculate the rate constant for the gas-phase reaction $OH + H_2 \rightarrow H_2O + H$. Author

N65-11882# Brussels U. (Belgium)
VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURES: PART XVII: THERMODYNAMIC STUDY OF TIN SELENIDE AND TIN TELLURIDE USING A MASS SPECTROMETER
R. Colin and J. Drowart Wright-Patterson AFB, Ohio. RADC, Sep. 1964 27 p refs
(Contract AF 61(052)-225)
(WADD-TR-60-782, Pt. XVII; AD-607792)

In a mass spectrometric investigation of the vapor in equilibrium with solid SnSe and solid SnTe, a number of reaction enthalpies were measured that, combined with known thermochemical data, yield the following:

$Sn(s) + Se(s) \rightarrow SnSe(s)$, $\Delta H^{\circ}_{298.1}(SnSe) = -19.9 \pm 2.0$ kcal/mole;
$Sn(s) + Te(s) \rightarrow SnTe(s)$, $\Delta H_{298.1}(SnTe) = -14.5 \pm 2.0$ kcal/mole;
$SnSe(g) \rightarrow Sn(g) + Se(g)$, $D^{\circ}(SnSe) = 95.0 \pm 3.0$ kcal/mole;
$SnTe(g) \rightarrow Sn(g) + Te(g)$, $D^{\circ}(SnTe) = 79.8 \pm 3.0$ kcal/mole;
$Sn_2Se_2(g) \rightarrow 2SnSe(g)$, $\Delta H^{\circ}_{298.dim}(SnSe) = 45.6 \pm 5.0$ kcal/mole;
$Sn_2Te_2(g) \rightarrow 2SnTe(g)$, $\Delta H^{\circ}_{298.dim}(SnTe) = 46.8 \pm 6.0$ kcal/mole;
and $SnTe_2(g) \rightarrow Sn(g) + 2Te(g)$, $\Delta H^{\circ}_{298.at}(SnTe_2) = 124.1 \pm 4.0$ kcal/mole.

The dissociation energies are compared to the available spectroscopic data. Author

N65-11884# Michigan U., Ann Arbor College of Literature, Science, and the Arts
VIBRATION-ROTATION SPECTRUM OF MATRIX ISOLATED AMMONIA Technical Report No. 3
Robert E. Meredith (Ph.D. Thesis) Nov. 1963 75 p refs *Its* Rept.-03640-3-T
(Contract AF 19(604)-6125)
(AFCRL-64-459; AD-607942)

An investigation of NH_3 and ND_3 isolated in inert gas matrices at 4.2° K has been made in the regions of the ν_1, ν_2, and ν_3 fundamentals, and in the vicinity of the overtone $2\nu_4$. The spectra were scanned with spectral slit widths ranging from 0.1 to 0.5 cm^{-1}, and it was found that this resolution was adequate to insure that all the observed line widths and shapes were free from instrumental broadening. The ν_2 fundamental has been interpreted in terms of a free rotation model, with the line spacing and inversion splitting having values very close to those observed for gas phase molecules. This interpretation confirms the existence of E-type and A-type (i.e., para and ortho) ammonia, although a substantial amount of nuclear spin conversion from E-type to A-type has been found. The interpretation of the ν_1, ν_3, and $2\nu_4$ spectra was much more difficult, but it was possible to determine the dependence of the lines on the ratio of inert gas atoms to ammonia molecules, and to assign the transitions involved as arising from either single isolated molecules or from ammonia complexes caused by incomplete isolation. Author

N65-11892# Aberdeen Proving Ground, Md. Coating and Chemical Lab.
AN INFRARED ABSORBANCE RATIO METHOD FOR THE DETERMINATION OF PHTHALIC ANHYDRIDE IN ALKYD-NITROCELLULOSE LACQUERS
M. L. Adams 8 Sep. 1964 13 p refs
(CCL-165; AD-607456)

A rapid quantitative method for the determination of the phthalic anhydride content in phthalic alkyd–nitrocellulose lacquers uses an infrared absorbance ratio technique applied to solvent free films of isolated vehicles. The method is dependent upon the previously determined nitrocellulose concentration. The potential extension of this principle to the determination of the phthalic anhydride content in enamels is discussed and illustrated. Author

N65-11901*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FLUORINE UPTAKE OF FLUOROCARBON GREASES
Patricia M. O'Donnell Washington, NASA, Dec. 1964 5 p ref
(NASA-TN-D-1911) OTS Prices: HC $0.50/MF $0.50

The fluorine uptake of four-fluorocarbon greases was studied in a glass apparatus at 100° C and a fluorine pressure of 110 mm of mercury. The reactivity varied with the composition of the greases. The lowest fluorine uptake was observed

with a grease formulated with polychlorotrifluoroethylene as the base material and a perfluorocarbon filler. When the same base material was retained and the filler was changed to a silica filler, a high fluorine uptake was observed. Author

N65-11921# International Union of Pure and Applied Chemistry, Basle (Switzerland) Commission on High Temperatures and Refractories

BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, VOLUME 1964, NUMBER 3, JULY, AUGUST, SEPTEMBER 1964

J. J. Diamond (NBS, Washington, D.C.), ed. 1964 68 p refs

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N65-11956# Mound Lab., Miamisburg, Ohio

POLONIUM-210 PROCESSING

F. D. Lonadier and F. M. Huddleston 26 May 1964 19 p Presented at the Radioisotope Production Technol. Meeting, Germantown, Md., 11–12 Jun. 1964

(Contract AT(33-1)-GEN-53)

Bismuth slugs are irradiated at the Hanford reactor. The concentration-cell cycle includes the dissolution of the decanned slugs in a mixture of hydrochloric and nitric acid, the denitration of the resulting product solution, the scrubbing of the bismuth chloride–polonium chloride solution on a bismuth bed containing 140 to 200 mesh bismuth powder, and the dissolution of the bismuth bed in a mixture of hydrochloric and nitric acid. The process operation continues with the denitration of the polonium solution, the scrubbing of the resulting solution on the bismuth bed, the dissolution of the bed in hydrochloric acid catalyzed by hydrogen peroxide, the precipitation of the polonium metal by reduction with stannous chloride, the dissolution in hydrochloric acid with hydrogen peroxide, the precipitation of the polonium as the hydroxide, and the dissolution of the hydroxide in dilute nitric acid. Polonium metal is obtained by electrodeposition onto platinum gauzes under a controlled voltage. The gauzes are rinsed with water and acetone, and are dried. Packaging and storage are also described. R.L.K.

N65-11982# Oak Ridge National Lab., Tenn. Isotopes Div.

DEVELOPMENT AND USE OF A PROCESS FOR CRYSTALLIZATION OF CESIUM TETRAOXALATE: AN INTERMEDIATE FOR PREPARING ^{137}Cs SOURCE COMPOUNDS

R. E. Lewis Nov. 1964 21 p refs

(Contract W-7405-ENG-26)

(ORNL-3667)

A process was developed for crystallization of cesium tetraoxalate, $CsH_3(C_2O_4)_2 \cdot 2H_2O$. Addition of oxalic acid to cesium-rich solutions precipitates more than 90% of the cesium as the tetraoxalate under optimum conditions. Cesium alum is converted to cesium tetraoxalate in 70% yield with cocrystallization of < 1% aluminum. Cesium remaining in solution is recycled, giving low process losses. The oxalate was demonstrated to be sufficiently stable to radiation to be useful as an intermediate in processing fission-product ^{137}Cs. Cesium tetraoxalate is calcined at 450° C to cesium carbonate, which is readily converted to cesium salts or glasses. Author

N65-11986# Louisiana State U. and Agricultural and Mechanical Coll., Baton Rouge

ON IMPEDANCE MEASUREMENTS: THE DETERMINATION OF THE DOUBLE LAYER CAPACITANCE IN THE PRESENCE OF AN ELECTRODE REACTION. CAPILLARY RESPONSE AT A DROPPING MERCURY ELECTRODE

R. de Levie Aug. 1964 34 p refs Submitted for Publication

(Contract Nonr-1575(04))

(TR-53; AD-604906)

A solution film inside the capillary is the principal locus of shielding at a DME. A graphical method for obtaining the true double-layer capacitance is presented, and a model is given that represents the electrical characteristics of the solution film. Author

N65-11999# Union Carbide Research Inst., Tarrytown, N.Y.

MASS SPECTROMETRIC STUDY OF ZIRCONIUM DIBORIDE

O. C. Trulson and H. W. Goldstein Oct. 1964 15 p refs

(Contract DA-30-069-ORD-2787)

(C-25; AD-450678)

A mass spectrometer was used with a high-temperature Knudsen effusion source to obtain vapor-pressure data for zirconium diboride in the temperature range 2267° to 2445° K. The heat of vaporization at 298° K determined from a third-law analysis of the data is $\Delta H^{\circ}_{298} = 474.5 \pm 5.3$ kcal/mole. Vapor-pressure data for zirconium and boron were also obtained; the third-law heats of vaporization are $\Delta H^{\circ}_{298} = 141.8 \pm 3.3$ kcal/mole, for zirconium, and $\Delta H^{\circ}_{298} = 130.3 \pm 3.3$ kcal/mole, for boron. The corresponding heat of formation of zirconium diboride at 298° K is $\Delta H^{\circ}_{298} = -72.1$ kcal/mole. Separate vapor-pressure measurements made on ZrB_2 mixed with C in a graphite crucible gave the result $\Delta H^{\circ}_{298} = -74.5$ kcal/mole. Author

N65-12001# Cincinnati U., Ohio

SYNTHESIS AND UTILIZATION OF THE CARBONYLS OF ORGANOMERCURY COMPOUNDS Report Period, 1 Sep. 1963–30 Aug. 1964

Raymond E. Dessy [1964] 9 p refs

(Grants DA-ARO(D)-31-124; NSF-G-14182)

(AD-450844)

The following mercurial derivatives of C_6Cl_5 have been prepared: $(C_6Cl_5)_2Hg$, C_6Cl_5HgCl, $C_6Cl_5HgCH_3$ and $C_6Cl_5HgC_6H_5$. Acid attack on the latter two species leads to scission of the C_6Cl_5—Hg and C_6H_5—Hg bonds, respectively, in agreement with the C_6F_5—Hg compounds. Like the latter, these pentachlorophenyl derivatives have a very high thermal stability. Author

N65-12002# State U. of Iowa, Iowa City

THE STRUCTURE OF METAL-OLEFIN COMPLEXES Final Report, 1 Mar.–31 Jul. 1964

Norman C. Baenziger and J. R. Doyle [1964] 16 p refs
(Contract DA-ARO(D)-31-124-G26)
(AROD-3072-10; AD-450851)

The preparation and reactions of metal–olefin complexes were investigated. The investigations were concerned mainly with producing suitable crystalline samples and ancillary information to assist in X-ray diffraction studies, finding new methods of preparation and new examples of unique metal–olefin compounds. Metals considered include platinum compounds, palladium compounds, copper, and silver. In studying the structure of metal–olefin complexes the following were considered: (1) refinement of the NBD-$PdCl_2$ (NBD = norbornadiene) structure; (2) structures of NBD-CuCl and COT-CuCl (COT = cyclooctatetraene); (3) structure of dipentene-$PtCl_2$; and (4) work on COT-$PdCl_2$ structures. P.V.E.

N65-12026# Ohio State U., Columbus Rocket Research Lab.
SHOCK TUBE DECOMPOSITION OF NITROUS OXIDE Interim Technical Report
E. Stokes Fishburne, Daniel M. Bergbauer, and Rudolph Edse
Wright-Patterson AFB, Ohio, ARL, Oct. 1964, 41 p refs
(Contract AF 33(657)-8951)
(ARL-64-143; 608467)

The thermal decomposition of nitrous oxide has been studied in the temperature region from 1500° to 2200° K. At temperatures higher than 2200° K the rate of decomposition is too rapid for accurate measurements. Shock tube techniques, employing the region behind the initial shock wave, were used. Because of the exothermic nature of the decomposition of nitrous oxide, it was necessary to study mixtures of nitrous oxide in an excess of diluent. The gases normally used as diluents were argon, nitric oxide, oxygen, and air. In general, the concentration of nitrous oxide was 2% by volume with 98% diluent. The results obtained with nitric oxide as a diluent indicate that the reaction is bimolecular. The rate constant derived from these experiments is in excellent agreement with the rate constant obtained by other investigators at lower temperatures. The data obtained with argon, oxygen, or air as diluents indicate that the decomposition is bimolecular at low concentrations and becomes monomolecular at higher concentrations. Author

N65-12048# Princeton U., N.J. Guggenheim Labs. for the Aerospace Propulsion Sciences
THE GAS PHASE DECOMPOSITION OF HYDRAZINE PROPELLANTS
Igor J. Eberstein 1964 137 p refs
(Contract AF 49(638)-1268)
(TR-708; AD-607334)

The decomposition of hydrazine, hydrazine–water mixtures, UDMH, and monomethylhydrazine was studied in an adiabatic flow reactor, and the progress of the reactions was measured by the longitudinal variation of the temperature. The overall reaction order of all three monopropellants was found to be very close to unity, and the first-order rate constants were obtained for their decomposition in a 3-inch duct. A comparison of the reaction rates of the three monopropellants showed that the UDMH decomposition is fastest; the hydrazine decomposition is slowest; and the monomethylhydrazine decomposition rate is intermediate. The hydrazine–water mixtures showed a slower decomposition rate than the anhydrous material by approximately a factor of 10. A postulation and analysis of the reaction mechanism for the thermal gas-phase decomposition of hydrazine and its methyl derivates are also presented. G.G.

N65-12083*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECTS OF CONCENTRATION AND VIBRATIONAL RELAXATION ON INDUCTION PERIOD OF HYDROGEN-OXYGEN REACTION
Frank E. Belles and Milton R. Lauver Washington, NASA, Dec. 1964 16 p refs
(NASA-TN-D-2540) OTS Prices: HC $0.50/MF $0.50

The possibility that slow vibrational relaxation of oxygen (O_2) or hydrogen (H_2) might affect the induction period of the high-temperature H_2–O_2 reaction is considered in terms of the data from three different kinds of shock-tube experiments. The data cover a wide range of initial composition and temperature and include observations in H_2–air, H_2–O_2–argon (Ar), and H_2–O_2 mixtures. It is found that induction times in excellent agreement with experimental data can be calculated by solving the differential rate equations based on the following simple kinetic scheme: an initiation reaction between molecular species, plus the three usual chain-branching reactions. It is not necessary to invoke vibrational effects to obtain this agreement, but it is necessary to solve the problem without incorporating steady-state assumptions or limitation on relative concentrations of H_2 and O_2. Thus, it is concluded that existing data exhibit little or no effect of slow vibrational relaxation. In support of this conclusion, calculations are presented to show that the greatest possible effect of slow O_2 relaxation would, in fact, be a small one. The calculations were carried out by making the extreme assumption that all the activation energy of the slow chain-branching step must be supplied by vibrational energy of O_2. Since the level of this energy varies during the induction period in a manner governed by the vibrational relaxation time, the reaction rate constant becomes time dependent. Unfortunately, the equivalent calculations for H_2 cannot be made because the relaxation time of H_2 in the presence of O_2 is not known. Author

N65-12135# Massachusetts U., Amherst Polymer Research Inst.
THE INTERNAL FIELD OF A n-PARAFFIN CRYSTAL. I: A CONTINUUM APPROACH Progress Report
Richard S. Stein 7 Aug. 1964 32 p refs
(Contract Nonr-3357(01))
(NSF-PR-3; ONR-TR-71; AD-607106)

A model is derived through which it is possible to calculate a value of anisotropy typical of some values proposed in an earlier publication. Results show that the discrepancy between the Denbigh and Bunn–Daubeny polarizabilities of the carbon-carbon bond is a consequence of the neglect by the latter investigators, of the anisotropy of the internal field. D.E.W.

N65-12136# Massachusetts U., Amherst Polymer Research Inst.
THE POLARIZABILITY OF MOLECULES CONSIDERING INTERNAL FIELD EFFECTS USING A POINT DIPOLE APPROXIMATION Progress Report
Earl M. Mortensen 1 Sep. 1964 19 p
(Contract Nonr-3357(01))
(NSF-PR-4; ONR-TR-72; AD-607108)

This analysis considers each bond in a molecule as a polarizable unit, and then transforms these polarizabilities to a common set of axes. A dipole moment is introduced to set up an electric field that can induce dipoles in other bonds, and the proper equations are formed to transform the polarizability from one set of axes to another set of axes. The geometrical relationship between an arbitrary coordinate system and the bond coordinate systems in a triatomic molecule is presented. G.G.

N65-12163# Brussels U. (Belgium)
VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURES. PART XXIV: MASS SPECTROMETRIC DETERMINATION OF THE STABILITY OF GASEOUS MOLYBDATES, TUNGSTATES, MOLYBDITES AND TUNGSTITES OF MAGNESIUM, CALCIUM, STRONTIUM AND TIN
G. Verhaegen, R. Colin and J. Drowart Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 17 p refs
(Contract AF 61(052)-225)
(WADD-TR-60-782, Pt. XXIV; AD-607780)

A number of ternary oxides have been identified in the gas phase by mass spectrometry, while vaporizing MgO, CaO, SrO, and SnO_2+Sn from Mo and W crucibles. The approximate stabilities of the gaseous molecules $MgMoO_4$, $CaMoO_4$, $SrMoO_4$, $MgWO_4$, $CaWO_4$, $SrWO_4$, $SrMoO_3$, $CaWO_3$, $CaMoO_3$, $SnWO_4$, and Sn_2WO_5 were deduced from the measurements. The dissociation energies (kcal/mole) into gaseous oxides are presented. Author

N65-12176# Battelle Memorial Inst., Columbus, Ohio
RADIATION-INDUCED CHANGES IN METHACRYLATE POLYMERS AND THEIR APPLICATION IN POSTIRRADIATION GRAFT POLYMERIZATION
Richard Markle, Francis A. Sliemers, John F. Kircher, William B. Gager, and Robert I. Leininger 11 Nov. 1964 44 p refs
(Contract W-7405-ENG-92)
(BMI-1695) OTS: $1.00

The effects of gamma irradiation on polymethacrylates in vacuo and polymethylmethacrylate in oxygen were studied. A mechanism for free-radical formation in the polymethacrylates in vacuo was evolved on the basis of esr studies of radical structures, analysis of volatile products of irradiation, and molecular-weight changes. A tentative scheme of peroxide formation was developed on the basis of this mechanism for free-radical formation. The work indicated that oxygen reduces the amount of chain degradation occurring in polymethylmethacrylate and that stable peroxides are formed that can be used to initiate polymerization. Polymerization yields depend on the total dose, dose rate, irradiation temperature, and molecular weight utilized in the peroxidation step. Author

N65-12181# Iowa State U. of Science and Tech., Ames Ames Lab.
MOMENTUM TRANSPORT IN PACKED COLUMNS USING STOCHASTIC MODELS
Charles B. Schriver and Raymond W. Fahien Nov. 1963 153 p refs
(Contract W-7405-ENG-82)
(IS-816)

The mean momentum loss and the variation in momentum loss for a group of packed beds having a similar structure were studied using a stochastic approach. The packed bed is considered as being composed of layers of independent momentum sinks called momentum cells. Each momentum cell consists of a piece of packing and the associated fluid surrounding it. The boundary of the cell is the locus of the points of maximum velocity between pieces of packing. The momentum cell properties used were calculated from measurements made on experimental packed beds constructed of wax and cork. The packings studied were spheres, cylinders, and Raschig rings. The effect of column to particle diameter and the method of packing were also studied. These experimental beds were sectioned, and photographs of the sections were taken to provide information on the internal structure of the beds. The variation of porosity with radial position, and the distribution of packing within the bed were studied. These photographs and measurements emphasize the importance of the region near the wall and how the flow is channeled in this region. The calculated momentum cell properties are presented in the form of frequency distributions or histograms. Author

N65-12187# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
AN APPROACH TO THE PREPARATION OF POWDERS, FIBERS, AND FILMS OF ULTRA-HIGH PURITY CERAMICS Technical Documentary Report, Aug. 1963–Aug. 1964
K. S. Mazdiyasni and C. T. Lynch Sep. 1964 42p refs
(ML-TDR-64-269; AD-608043)

Transition and rare-earth metal alkoxides have been investigated. Compounds of the type $M(OR)_3$ and $M(OR)_4$ where M is Ti, Zr, Hf, Th, Y, Yb, and Dy, and various alkyl groups such as C_4H_9— and C_5H_{11}— have been studied. The metal–oxygen bond in these compounds is very stable, and thermal decomposition is complete to the oxides. A method has been developed to produce, on a continuous basis, zirconia and hafnia with an average particle size of less than 100 Å and a purity of 99.9$_5$+percent. Adherent coatings of refractory oxides on graphite have been made by thermal decomposition of the alkoxides at the substrate surface. Author

N65-12194# Ohio State U., Columbus
THE STABILITY OF TUNGSTEN IN CARBURIZING AND OXIDIZING ATMOSPHERES Technical Documentary Report, 1 Mar. 1961–28 Feb. 1964
J. E. Battles, R. Speiser, and G. R. St. Pierre Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1962 49 p refs
(Contract AF 33(616)-8005)
(ML-TDR-64-272; AD-608103)

This report is based primarily on the mass spectrometric investigations of the tungsten–oxygen vapor species. The dissociation energies of W_2O_6, W_3O_9, and W_4O_{12} to the atoms have been determined. In addition, the equilibrium vapor over condensed W/WO_2 and $W_{20}O_{58}/WO_3$ were measured. Studies on interaction between the oxides of tungsten and water vapor are also reported. Author

N65-12195# Union Carbide Corp., Parma, Ohio Carbon Products Div.
HIGH TEMPERATURE PROTECTIVE COATINGS FOR GRAPHITE Technical Documentary Report, 1 Jun., 1963–31 May 1964
J. M. Criscione, R. A. Mercuri, E. P. Schram, A. W. Smith, and H. F. Volk Wright-Patterson AFB, Ohio, AF Materials Lab., Oct. 1964 154 p refs
(Contract AF 33(657)-11253)
(ML-TDR-64-173; Pt. II; AD-608092)

A comprehensive program to provide fundamental information concerning various factors controlling the oxidation behavior of protective coating systems for graphite at temperatures up to 2200° C is outlined and described. Work presented includes the evaporation of iridium in the presence of oxygen and water vapor to temperatures of 1300° C; the results of studies involving carbon diffusion through iridium; the permeability of iridium, rhodium, ZrO_2, HfO_2, and ThO_2 to oxygen at temperatures of 2000° C; the coating of graphite with iridium, including the carbon–iridium eutectic-temperature determination; the reactions of iridium and rhodium with ZrB_2, HfB_2, ZrC, HfC, and ThC_2; the kinetics of the carbothermic reduction of ZrO_2, HfO_2, and ThO_2 to temperatures in excess of 2000° C; the chemical reactions of graphite with ZrB_2 and HfB_2; and arc-plasma tests of iridium-coated graphite. Author

N65-12197# Callery Chemical Co., Pa.
STUDIES OF COMPLEX PERCHLORATES Annual Report
C. R. Guibert, H. F. Klodowski, and A. D. Mc Elroy 27 Oct. 1964 27 p ref
(Contract Nonr-3934(00))
(AD-607947)

One complex perchlorate of beryllium ($(NO_2)_2Be(ClO_4)_4$) was prepared and characterized. Preliminary efforts to synthesize $((CH_3)_4N)_3Al(NO_3)_6$ gave encouraging results. Infrared and Raman spectra of several complex perchlorates were obtained. These spectra indicate covalent character on the part of the coordinated perchlorate group. Author

N65-12253# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
QUANTITATIVE DETERMINATION OF DOUBLE BONDS IN UNSATURATED SILICO-ORGANIC COMPOUNDS BY SPECTRAL ABSORPTION IN THE INFRARED REGION
Yu. Ya. Mikhaylenko, L. P. Senetskaya, and Ye. G. Kutyrina 27 Aug. 1964 9 p refs Transl. into ENGLISH from Tr. Akad. Nauk SSSR, Komis. Po Analit. Khim. (Moscow), v. 13, 1963 p 383–388
(FTD-TT-64-458/1+2; AD-605801)

The proposed method for quantitative determination of the double bonds in silico-organic compounds is based on the use of the integral coefficient of absorption. A detailed procedure for detecting divinyl-tetraethoxy-disilozane $(CH_2 = CH)_2 —(C_2H_5O)_4Si_2O$ in a solution of carbon disulfide and for detecting vinyl-triethoxysilane $CH_2 = CH—Si(OC_2H_5)_3$ in a solution of carbon disulfide is presented. P.V.E.

N65-12257# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
ULTRAHIGH VACUUM TECHNIQUES Annual Report, Jan. 1–Dec. 31, 1963
D. W. Feldman, W. J. Lange, M. Rabinowitz, J. H. Singleton, and R. J. Zollweg 26 Feb. 1964 39 p refs *Its* Res. Rept.-64-928-441-R2
(Contract AT(30-1)-2823)
(WERL-9)

The following topics are presented: "Development of Components and Techniques"—electron sources, high-sensitivity mass spectrometers, and Teflon wall coatings for ultrahigh-vacuum systems; "Particle Interaction at Surfaces"—photodesorption, thermal desorption, the electron reflection at metal surfaces, and the inelastic collisions of electrons at surfaces; "Basic Phenomena Limiting the Attainment of Ultrahigh Vacuum"—the residual gases in an ultrahigh-vacuum system, and the evolution of carbon monoxide from tungsten. G.G.

N65-12322# Research Triangle Inst., Durham, N.C. Measurement and Controls Lab.
A RADIO-RELEASE TECHNIQUE FOR THE MEASUREMENT OF MOISTURE IN GASES Final Report
Harold G. Richter and Arthur S. Gillespie, Jr. Washington, AEC, 31 Jan. 1964 15 p refs
(Contract AT(40-1)-2513)
(ORO-591) OTS: $0.50

A radio-release procedure for the determination of minute quantities of water vapor in gases was investigated. The gas containing water vapor was passed through a column of radioactive calcium carbide (CaC_2^{14}). The acetylene ($C_2^{14}H_2$) generated from the chemical reaction then passed over a Geiger–Mueller counter whereupon the count-rate was a direct measure of the water vapor content of the original gas. The ultimate sensitivity of the reaction assuming a 1% counting efficiency, a counting cell of 1-ml volume, and the highest specific activity CaC_2^{14} available being 10 mc/millimole, was calculated to be about 0.4 microns partial pressure of water vapor in the gas. This sensitivity was not achieved because the CaC_2^{14} contained gross amounts of unreacted calcium and barium metal impurities, together with an unknown amount of CaO and $Ca(OH)_2$. All of these perturb the reaction, especially since the material is inhomogeneous. A further limitation is the formation of $Ca(OH)_2$ and/or CaO on the surface of the CaC_2^{14} particles, which impedes reaction as the coating builds up. Author

N65-12330# Atomic Energy of Canada Ltd., Chalk River, Ontario
AN INFRARED METHOD FOR DETERMINING VARIATIONS IN THE DEUTERIUM CONTENT OF NATURAL WATER
J. G. Bayly, W. H. Stevens, and W. M. Thurston Jan. 1964 14 p refs
(AECL-2076; CRDC-1141)

A laboratory method of analysis for determining variations in the deuterium content of water near the natural concentration level ($D/H+D \approx 0.0148$ at. %) is described. Concentration differences of 0.0002 at. % between two samples can be detected. The method was developed to test concepts for an improved on-stream monitor to detect leakage of heavy water into natural water in a heavy-water power reactor. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-10963# Narmco Industries, Inc., San Diego, Calif.
HIGH-TEMPERATURE STRUCTURAL ADHESIVES Final Summary Report, 1 Mar. 1963–15 Apr. 1964
Paul M. Hergenrother, Wolfgang J. Wrasidlo, and Harold H. Levine 15 Apr. 1964 96 p refs
(Contract NOw-63-0420-C)
(AD-602679)

Processable prepolymers of polyimides, polybenzothiazoles, and polyquinoxalines were prepared and advanced to high molecular weight polymers possessing excellent hydrolytic, oxidative, and thermal stability. Preliminary 2-ply laminates gave average flexural strength and modulus values, at room temperature, of 64 190 psi and 3.37×10^6 psi for poly(*m*-phenylene-3,3',4,4'-benzophenonetetracarboxylimide); 53 600 psi and 3.59×10^6 psi for poly-2,2'-[p,p'-oxybis(phenylene)-6,6'-bibenzothiazolyl]-2,2'-(3,5-pyridinediyl)-6,6'-bibenzothiazole; 34 370 psi and 2.46×10^6 psi for poly-2,2'-(*p*-phenylene)-7,7'-biquinoxaline respectively. A kinetic study of the reaction of *m*-phenylenediamine and pyromellitic dianhydride showed the initial reaction was second order and the cyclization to an imide was first order. A method employing infrared spectroscopy was developed to aid in the selection of a prepolymer containing minimal condensation volatiles while maintaining good solubility and fusibility necessary for processing. Author

N65-10972# Air Proving Ground Center, Eglin AFB, Fla.
DEVELOPMENT OF A BROADBAND MULTIBLADE ROCKET-BORNE BEACON ANTENNA

Calvin W. Miley Jul. 1964 41 p refs
(APGC-TDR-64-46; AD-447003)

This report contains information on the development, testing, and utilization of a broadband multiblade antenna. The objective of this research was to provide an antenna with a characteristic impedance of near 50 ohms over a broadband of frequencies. It was desirable that the antenna would lend itself toward ease of design and fabrication, keeping in mind the necessity for aerodynamic stability and a low silhouette. The antenna must also provide good radiation pattern coverage to the rear or aft of the payload. The results of this investigation in relation to radiation patterns, as well as to impedance plots and VSWR curves, are summarized. Author

N65-10974# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PENETRATION AIDS: AN ANNOTATED BIBLIOGRAPHY, JUNE 1963–JUNE 1964
Peter R. Stromer, comp. Oct. 1964 174 p refs
(B-07-64-3; SB-64-17)

Penetration aids are defined as those devices and techniques that confuse, deceive, and overwhelm hostile detection and tracking radar, thus enabling ballistic missiles to penetrate to their assigned targets. Included are chaff, countermeasures, decoys, maneuvering reentry vehicles, and nuclear precursors, used singly or in various combinations. Author

N65-10978# Ohio State U. Research Foundation, Columbus Antenna Lab.
GEOMETRICAL OPTICS FOR GYROTROPIC BODIES Scientific Report No. 27
W. C. Y. Lee, L. Peters, Jr., and C. H. Walter 15 Apr. 1964 41 p refs *Its* Rept.-1116-45
(Contract AF 19(604)-7270)
(AFCRL-64-716; AD-606094)

The methods of geometrical optics are extended so that they may be applied to gyrotropic bodies. Various internal and external reflections are considered at nonparallel planar interfaces, and means of determining the ray path or directions of energy flow are derived. Nonplanar geometrics may be represented by the tangent planes at the various points of incidence. A method is given for computing the phases of the various fields. These values may be used to determine the reflected fields from such a gyrotropic body. Author

N65-10984# Lincoln Lab., Mass. Inst. of Tech., Lexington
A METHOD FOR EVALUATING A GENERALIZED FRESNEL INTEGRAL RELATED TO THE SPECTRA OF AMPLITUDE AND FREQUENCY MODULATED PULSES Group Report 1964–43
E. B. Temple 5 Aug. 1964 37 p
(Contract AF 19(628)-500; ARPA Order 498) Proj. Defender)
(ESD-TDR-64-360; AD-604480)

Asymptotic expressions for the Fourier spectra of pulses modulated by a carrier frequency plus linear FM are obtained for several pulse shapes, using an asymptotic series for the complex Fresuel integral. A geometric interpretation of the terms in this series is given. Author

N65-10999# National Weather Satellite Center, Washington, D.C. Meteorological Satellite Lab.
DOCUMENTATION FOR TIROS IV TELEVISION DATA
Robert L. Pyle May 1963 88 p refs
(MSL-16)

Data required for the use of photogrammetric techniques to locate geographically the image features on TIROS IV satellite television pictures are provided. The three basic parameters involved are these: (1) the satellite's position in space; (2) the satellite's attitude; and (3) the image distortion introduced by the optical and electronic systems of the spacecraft and ground station. Machine programs were developed that accept the basic parameters as input, compute position information, and draw a grid of latitude and longitude lines to be overlaid on the picture. The accuracy of machine-computed grids is limited by neglect of the asymmetric component of distortion and neglect of time changes in electronic distortion, and frequently by imprecise knowledge of satellite attitude and time of picture exposure. Nevertheless, computed grids provide excellent approximate maps for the pictures, and in sequences with good input data, the accuracy can be nearly as good as that obtained with the most elaborate hand techniques. R.L.K.

N65-11033# University of Southern Calif. Engineering Center, Los Angeles
ON THE ESTIMATION OF SIGNAL TO NOISE RATIO AND APPLICATIONS TO DETECTION AND TRACKING SYSTEMS Interim Technical Documentary Report
N. E. Nahi and R. M. Gagliardi Jul. 1964 27 p refs
(Contract AF 04(695)-537)
(USCEE-114; SSD-TDR-64-206; AD-446811)

An essential problem in the detection and tracking of an object, such as a space vehicle, is the task of extracting the received signal from perturbing noise or detecting its presence. Such operations require knowledge of the input signal-to-noise ratio. The forms of the spectra of the signal and noise are usually invariant during a mission, since these properties are determined by transfer functions of system elements such as the antenna, crystal filters, and mirrors. However, the power in the received signal, whether from radar or laser illumination, generally varies during any mission due to changes in target-receiver range, or changes in the properties of the media masking the target. In addition, the power in the corrupting noise will also vary as a result of changes in the clutter background. Hence, it is desirous to have a device that will estimate input signal-to-noise ratio when the signal and noise each have power spectra known to within a multiplying constant. A technique is introduced where this ratio can be estimated during operation by means of a relatively simple mechanization. For the important special case of narrow-band signal in gaussian noise, it is shown that the suggested technique can be implemented by use of a limiter and a power measuring device. Author

N65-11063# Weapons Research Establishment (Australia)
A GENERAL PURPOSE TELEVISION RECEIVER
C. B. Wason May 1964 22 p refs
(WRE-TN-PAD-88)

This paper covers the design, operation, and performance of a television receiver designed primarily to meet the requirements of an air-ground-TV link. The design is based on the Australian TV standards of transmission, and the receiver covers all 13 Australian channels. However, inherent in the design is the ability to operate on double sideband signals, insensitivity to detuning, maximum video resolution for a given bandwidth, fast AGC action, and the automatic frequency control of IF carrier frequency. Author

N65-11067# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
PEDESTAL DYNAMICS OF A TWO-AXIS PEDESTAL

Robert Harrington and Robert Livingstone 5 Aug. 1963 30 p (Contract DA-36-039-AMC-00088(E))
(EDL-M566; AD-423607)

A two-axis pedestal has certain tracking limitations that become exaggerated when tracking in the vicinity of the tracking station. The limitations of the pedestal described quantitatively in this report involve angular velocity, angular acceleration, and reacquisition capability. Tracking data are presented in the form of contours of constant angular rates (both velocity and acceleration) which are discussed in some detail. Equations are stated that describe the pedestal motion and are interpreted in terms of typical tracking stations. The general tracking equations are developed using the methods of tensor analysis. A discussion of tensor analysis in general is included. Author

N65-11072# Aerospace Corp., El Segundo, Calif. Telecommunications and Tracking Dept.
AN ANALYSIS OF ATHENA TRACKING PROBLEMS (THE ATHENA PORTION OF ABRES 627a)
Lawrence Norwood 18 Nov. 1963 41 p refs
(Contract AF 04(695)-169)
(TDR-169(3153-01)TN-6; BSD-TDR-63-144; AD-424691)

The Athena program has been conceived to provide a systematic method for investigation of atmospheric reentry phenomena and, through the use of a test vehicle especially designed to reproduce ICBM trajectory dynamics, to facilitate the evaluation of advanced reentry concepts. This report contains discussions on launch-radar-tracking precision, launch-radar optimum placement, radar-system and missile-transponder parameters, and maximum radar and missile-transponder tracking capability. Author

N65-11076*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
RESEARCH IN SPACE SCIENCE
25 Jun. 1964 39 p refs OTS Prices: HC $2.00/MF $0.50
(Grant NsG-87)
(NASA-CR-59490; SAO-SR-156)

CONTENTS:

1. BAKER-NUNN PHOTOGRAPHY OF THE SYNCOM II FOURTH-STAGE IGNITION Robert Citron and Leonard H. Solomon 18 p refs (See N65-11077 01-07)
2. TRACKING OF CENTAUR (AC-2) Leonard H. Solomon 18 p (See N65-11078 01-07)

N65-11077* Smithsonian Astrophysical Observatory, Cambridge, Mass.
BAKER-NUNN PHOTOGRAPHY OF THE SYNCOM II FOURTH-STAGE IGNITION
Robert Citron and Leonard H. Solomon *In its* Res. in Space Sci. 25 Jun. 1964 18 p refs (See N65-11076 02-07) OTS Prices: HC $2.00/MF $0.50

The film gave values, within ±4 seconds, of ignition time, duration, and burnout time. The unexpected brightness of the actual burn prevented greater accuracy, but the fact that it was easily filmed indicates that the Baker–Nunn system is capable of recording most rocket maneuvers in cislunar space. Author

N65-11078* Smithsonian Astrophysical Observatory, Cambridge, Mass.
TRACKING OF CENTAUR (AC-2)
Leonard H. Solomon *In its* Res. in Space Sci. 25 Jun. 1964 18 p (See N65-11076 02-07) OTS Prices: HC $2.00/MF $0.50

The Baker–Nunn system tracked the Centaur vehicle AC-2. The AC-2 was photographed 155 times during the first 10 days; orbits were analyzed for piece B and for piece A, which appeared to be accelerating. The film of the unplanned breakup (into five pieces) of AC-2 taken by the South Africa station indicates the time of the breakup and its probable relation to the abnormal acceleration of piece A. Author

N65-11084# RAND Corp., Santa Monica, Calif.
THE LIKELIHOOD RATIO FILTER FOR THE DETECTION OF GAUSSIAN SIGNALS IN WHITE NOISE
T. W. Mullikin and Ivan Selin Sep. 1964 21 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4207-PR; AD-606575)

This memorandum derives a solution to the equation $\rho(u,s) = N_0 h(s,u) + \int_0^T \rho(t,s)h(t,u)dt$, for the case in which the kernel is the covariance function of a stationary random process whose spectral density is a rational function of frequency. Author

N65-11091# Texas U., Austin Electrical Engineering Research Lab.
MEASUREMENT OF TOTAL CROSS SECTIONS OF WATER DROPS AT 5 MM WAVELENGTH UTILIZING THE "SHADOW THEOREM"
Kenji Funakawa Wright-Patterson AFB, Ohio, AF Avionics Lab., 10 Sep. 1964 35 p refs
(Contract AF 33(657)-8716)
(TR-9; AD-607510)

Total 5-mm-wavelength cross sections of falling waterdrops with radii between 1.25 mm and 3.38 mm were measured at two droplet-temperature intervals, 25° to 28° C and 2° to 5° C, using the shadow theorem, which relates the imaginary part of forward scattering coefficient to the total cross section. The experimental total-cross-section values were a little smaller than the theoretical values of the total cross sections of spherical waterdrops, and the differences between the experimental cross sections of the drops at the two temperatures were comparable to the experimental errors. Measurements were also made of total cross sections of metal spheres with radii between 1.98 mm and 4.35 mm as a preliminary verification of the theorem and were found to be in good agreement with theoretical values. Author

N65-11114# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HIGH FREQUENCY TECHNIQUES AND ELECTRO-ACOUSTICS Selected Articles
28 Sep. 1964 43 p refs Transl. into ENGLISH from Hochfrequenztech. u. Elektroakust. (Leipzig), v. 72, no. 5, 1963 p 155–163, 177–186
(FTD-TT-64-555/1+2; AD-607298)

CONTENTS:

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2. VARIOUS PROBLEMS OF PULSE-CODE MODULATION A. Ditl p 20–41 refs (See N65-11116 02-07)

N65-11115# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ARCHIMEDIAN SPIRAL ANTENNAS
K. Eberhard Mueller and K. Bahmann *In its* High Freq. Tech. and Electro-Acoustics 28 Sep. 1964 p 1–19 refs (See N65-11114 02-07)

It is shown that with the aid of the Kirchhoff–Huygens principle, and by the use of suitable equivalent currents, effective approximate calculations of the radiation characteristics of Archimedian spiral antennas can be limited to a resonance zone that forms the real radiation center, and in which the equivalent currents attain their maximum values. P.V.E.

N65-11116# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
VARIOUS PROBLEMS OF PULSE-CODE MODULATION
Augustin Ditl *In its* High Freq. Tech. and Electro-Acoustics 28 Sep. 1964 p 20–41 refs (See N65-11114 02-07)

A 12-channel experimental PCM system is described, and the advantages of a PCM system over other types of telephony-multiplex systems (e.g., PPM systems) are discussed. It is concluded that the most important advantages of PCM systems over other systems are based primarily on the following points: (1) The communication pathway for a video signal can be subjected to considerable interference without causing any interference in the telephone channel. (2) The video signal can be greatly distorted by the communication pathways without causing any interference in the telephone channels. (3) The video pulses are more often regenerated in a long relay line, so that the length of the line does not cause any damaging influence on the quality of the telephone transmission. P.V.E.

N65-11173# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
THE INFLUENCE OF RANDOM PHASE ERRORS ON THE ANGULAR RESOLUTION OF SYNTHETIC APERTURE RADAR SYSTEMS
Jean A. Develet, Jr. 20 Jun. 1963 44 p refs
(Contract AF 04(695)-169)
(TDR-169(3250-43)TN-4; SSD-TDR-63-130; AD-408761)

The influence of random phase errors on the angular resolution of a focused synthetic-aperture radar system is treated. The principal measure of performance has been taken as the mean envelope power at the system output. This system output power is evaluated exactly, although not in closed form, based on the following reasonable assumptions: (1) The real beam pattern is gaussian. (2) The random phase error is essentially a geometry-independent ergodic process with a gaussian amplitude distribution and zero mean. (3) The random phase error has a gaussian correlation function. Author

N65-11198# Lincoln Lab., Mass. Inst. of Tech., Lexington
ECHOLOCATION WITH WIDE-BAND WAVEFORMS: BAT SONAR SIGNALS Technical Report No. 271
D. A. Cahlander 6 May 1964 74 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-60; AD-605322)

The wideband, echo-locating sonar signals of bats are investigated with reference to statistical estimation theory to ascertain the implications of this class of signals. The work is divided into four major sections: (1) The concept of an ideal receiver for the simultaneous measurement of range and velocity of a target is extended to cover wide-band signals. (2) Angular localization of a target by means of a fixed, gain-dispersive antenna in the presence of additive gaussian noise is studied. (3) An ambiguity diagram computer is designed and built that calculates the signal function of an arbitrary waveform. (4) Ambiguity diagrams are calculated for several types of bat sonar signals emitted by the bat *Myotis lucifugus*, and one cruising signal emitted by the bat *Lasiurus borealis*. Author

N65-11210# Washington State U., Pullman
INVESTIGATION OF NORTH NOISE
Fredric C. Dunlap (M.S. Thesis) 1964 55 p refs
(AD-446727)

The occurrence of auroral noise or noise generated from somewhere to the geomagnetic north was investigated. The occurrence was correlated with the presence of field-alined irregularities in the auroral zone and also with the apparent increase of north noise prior to sudden commencements, magnetic activity, occurrence of field-alined echoes, and prior to a peak sunspot day. A majority of the data were obtained by fixed-frequency backscatter sounder records, and were evaluated by the chi-square test for excellence of fit. G.G.

N65-11217# Radio Corp. of America, New York, N.Y. New York Systems Lab.
SYSTEM ADAPTIVE TECHNIQUES: STUDY AND APPLICATION OF ADAPTIVE COMMUNICATION TECHNIQUES IN THE DEFENSE COMMUNICATION SYSTEM Report No. 3
5 Sep. 1964 150 p refs Sponsored by Defense Communications Agency
(CR-64-419-12; AD-447114)

This report on adaptive techniques for use in submarine cable, HF, and landline digital links of the Defense Communications System for the period 1970–1975, covers the landline phase of study, concludes the HF phase of study, and completes the work on adaptive, antidistortion systems presented in a previous report. D.E.W.

N65-11222# Litton Systems, Inc., Waltham, Mass. Information Sciences Lab.
LIMITING FORMS AND NON-GAUSSIAN STATISTICS IN SIGNAL PROCESSING THEORY, I
David Middleton 15 Apr. 1964 27 p refs
(Contract Nonr-3320(00))
(TR-64-6-BF; AD-603710)

This report presents an introductory study of representations of nonnormal processes and their approach to normality under special conditions. In particular, the Edgeworth series development is applied, in one and more dimensions, to obtain conditions for a process to exhibit gaussian structure, whether under discrete or continuous sampling on an interval. For the former, the usual condition is that of a large number of independent samples (essentially, the critical condition required in the central limit theorem), such that the Edgeworth correction terms vanish through all orders. It is shown, also, that this condition may not obtain for certain types of processes, where an alternative Laguerre development may be more appropriate, characterized by a form of χ^2-distribution with few degrees of freedom. Some processes that are inherently non-gaussian, such as the important Poisson process (an example of an infinitely divisible point process), become essentially normal when their point density becomes sufficiently great. Author

N65-11226# Tennessee U., Knoxville
CIRCULAR ARRAYS AROUND CYLINDERS Scientific Report No. 7
H. P. Neff, C. E. Hickman, and J. D. Tillman 1 Jun. 1964 55 p refs
(Contract AF 19(628)-288)
(AFCRL-64-537; AD-603965)

This report gives the theory of circular antenna arrays around cylinders. A résumé of the theory of simple circular arrays is given, and both the complete far-zone field, and an expansion into spherical modes is obtained. Both the far-zone pattern and an integral form for the impedance of a dipole near an infinite cylinder are obtained by Fourier transform

methods. By means of a limiting process, an approximate form is obtained for a dipole near a finite cylinder. It is shown that for all three cases, simple array, array around an infinite cylinder, and array around finite cylinder, the pattern can be placed in the same form. The application to pattern synthesis and electronic scanning is discussed. Author

N65-11228# Sperry Gyroscope Co., Great Neck, N.Y. Electro-Optics Group
COMPARATIVE TESTS OF BASIC OPTICAL DOPPLER RADAR TECHNIQUES Final Technical Report
R. D. Kroeger and E. W. Cheatham, ed. Wright-Patterson AFB, Ohio, AF Avionics Lab., Sep. 1964 38 p refs
(Contract AF 33(657)-11653)
(AB-1272-0014; AL-TDR-64-233; AD-606643)

Comparison tests of the direct, optical heterodyne system and subcarrier, modulated, optical doppler system were conducted. From the test results with diffuse targets, it was concluded that the subcarrier approach is more practical for space applications. The optical heterodyne system is advantageous (in resolution and accuracy) for measuring very low velocities (less than 1 ft/sec). A combined optical radar system was developed whereby each approach could be conveniently tested. The experimental equipment is described, including the criteria for aperture diameter and spot size. Comparative test results are presented in terms of signal-to-noise ratio, sensitivity, minimum detectable power, and resolution. Author

N65-11229# Illinois U., Urbana Radiolocation Research Lab.
AN ANALYSIS OF A VARIABLE RATE SERVOMECHANISM FOR A RADIO DIRECTION FINDING SYSTEM Technical Note No. 30
Hollis Franklin Ryan Jun. 1964 42 p refs
(Contract Nonr-1834(02))
(RRL-248; AD-603223)

A detailed analysis of an ac rate servomechanism is presented. The actual performance of the servo is compared to the desired performance. Two mathematical models of the servo are constructed from experimental data. The first model is the usual linear model using Laplace transforms; the second model is a quasi-linear model that includes a describing function representing the acceleration limiting of the servomotor. From the models, the sensitivity and stability of the servomechanism are calculated. Certain limitations of the models are pointed out. A large amount of experimental data is presented in graphical form. Author

N65-11242# Naval Research Lab., Washington, D.C. Applications Research Div.
A BROADBAND LINEAR ARRAY FOR SPACE SURVEILLANCE
C. A. Bartholomew 19 Jun. 1964 22 p refs
(NRL-6107; AD-603769)

A broadband linear array with minimum side lobes has been developed to meet several special requirements of the U.S. Navy Space Surveillance system. These requirements include simultaneous monitoring of a number of frequencies in the 100 to 500 Mc/sec band for the early identification and separation of satellites launched in multiple sets. The constructed arrays are 5600 ft long, consisting of 1080 biconical aluminum-rod elements above a ground screen. The VSWR is less than 2:1 over the frequency range 100 to 500 Mc/sec. An "offset" harnessing technique has been used to provide an amplitude distribution for minimum side lobes while maintaining the equal line lengths required for broadbanding. Good suppression of grating lobes exists to above 300 Mc/sec. Author

N65-11248# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ATMOSPHERIC TRANSMISSION FROM 4 TO 5 MICRONS
L. L. List and G. E. Oppel 10 Aug. 1964 58 p refs
(Contract AF 04(647)-787)
(LMSC-A667599; AD-446805)

The contributors to atmospheric absorption in the 4μ to 5μ spectral region include carbon dioxide, water vapor, and nitrous oxide. Absorption and transmission values were determined from theoretical calculations and compared to previously reported experimental results. Agreement was satisfactory for spectral regions where absorption constants had been experimentally determined from synthetic atmospheres. Agreement was also shown for coarse resolution by using quantum-mechanical relationships. Author

N65-11253# Tennessee U., Knoxville
INVESTIGATION OF THIN WIRE CIRCULAR LOOP ANTENNAS AND ELECTRONICALLY SCANNED CIRCULAR ARRAYS Final Report
H. P. Neff, C. E. Hickman, and J. D. Tillman 30 Jun. 1964 20 p
(Contract AF 19(628)-288)
(AFCRL-64-555; AD-603966)

The two principal results of the study of circular arrays are establishment of a comprehensive, rigorous treatment of circular arrays of axial dipoles and the development of a simple, amplitude-controlled circular array, capable of 360° electronic scanning. It has been well established that, except for a few mathematical manipulations involving Bessel functions, circular arrays are no more complicated than are linear arrays. Almost every form of linear array has its circular analog, and because of the circular symmetry, circular arrays have a number of inherent advantages. Author

N65-11258# Ohio State U. Research Foundation, Columbus Antenna Lab.
AN EXTENSION OF THE MODIFIED GEOMETRICAL OPTICS METHODS FOR RADAR CROSS SECTIONS OF DIELECTRIC BODIES
T. Kawano and L. Peters, Jr. *Its* Rept.-1116-38 15 Jan. 1964 49 p refs
(Contract AF 19(604)-7270)
(AFCRL-64-714; AD-606092)

The radar cross section of a dielectric sphere whose relative dielectric constant is significantly greater than unity is computed by means of the modified geometrical optics method. A new technique is introduced for treating the on-axis, internally reflected ray for the regions where the geometrical optics approach fails. Numerical calculations are made for the sphere whose specific dielectric constant is equal to 2.592 (i.e., refractive index is equal to 1.61). The results compare favorably with those obtained from the boundary-value solution. The contributions of the stationary rays are relatively large, and the rapid oscillations in the region of larger radius are attributed to the multiple-bounce stationary ray. Author

N65-11262# Electromagnetic Technology Corp., Palo Alto, Calif.
FREQUENCY CONVERTER UNITS FOR L-BAND, S-BAND, C-BAND, AND X-BAND Interim Development Report, 1-31 Aug. 1964
William A. Edson et al 15 Sep. 1964 11 p
(Contract NObsr-89536)
(IDR-14; AD-605537) OTS: $1.00

Improvements were made on the L-band double-balanced converter to provide some margin over the specification. Tests

of the up and down converter at full signal level were also conducted. Fabrication of two versions of an S-band converter was completed. Development work on the X-band double-balanced converter has proceeded with design, fabrication, and testing of components. Investigations of the spurious frequency output of the L-band converter were conducted, and it was concluded that performance is satisfactory. Author

N65-11266# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INTERFERENCE ANTENNA
A. P. Molchanov and V. M. Vyatkina 6 Aug. 1964 5 p Transl. into ENGLISH from Soviet Patent No. 155507 (764603/26-9), 17 Feb. 1962 2 p
(FTD-TT-64-479/1+2; AD-605237)

A proposed interference antenna is described that contains systems of turning panels that form a reflecting surface, and systems of fixed panels that form a focusing system with a fixed irradiator. A drawing portrays the scheme of the antenna in two projections. This proposed antenna is applicable in solar observations for the daily mapping of the radioactive radiation of the sun. G.G.

N65-11279# Naval Research Lab., Washington, D.C. Applications Research Div.
RADIO-INTERFEROMETER ANALOG PHASE-CHANNEL COMBINER (MOD II) FOR UNAMBIGUOUS SPACE ANGLE MEASUREMENTS IN THE NAVY SPACE SURVEILLANCE SYSTEM
M. G. Kaufman and C. H. Weaver 30 Oct. 1963 65 p refs
(NRL-5980; AD-423924)

The Navy Space Surveillance System, developed at the Naval Research Laboratory for the purpose of detecting nonradiating earth satellites, forms a radio fence along a great circle across the southern part of the United States. Four receiving sites alternate with three transmitting sites to form the fence. The transmitting stations illuminate satellites with radio energy as they cross the fence. The angle-of-arrival of the reflected signals is measured at each receiving station by a compound radio interferometer. These signals yield a multiplicity of channels of information that are normally recorded on paper, read, and resolved. Operationally, the resolution is done by a computer, but the angle-of-arrival can also be resolved by using slide rules and/or tables. The purpose of this report is to describe an electronic system, called the Mod II phase-channel combiner, that automatically combines several noisy phase channels into one quiet channel, with two additional channels being available for vernier readout. Author

N65-11320# Technical Research Group, Inc., Melville, N.Y.
DEVELOPMENT OF INTEGRATED X-BAND PARAMETRIC AMPLIFIER/CRYOGENIC REFRIGERATOR SYSTEM First Semiannual Report, 24 Jan.–24 Jul. 1964
R. Damiano and J. Kliphuis Jul. 1964 40 p refs
(Contract DA-36-039-AMC-03728(S))
(Rept.-1; AD-447379)

The step-by-step procedures involved in the development of a two-stage, integrally packaged, cryogenically cooled parametric-amplifier system are presented. Design curves for the theoretical optimum noise temperature and gain-bandwidth product of a one-port, nondegenerate parametric amplifier are included, along with the experimental data obtained to date. Measurements taken on ferrite circulators, a parametric amplifier, and on two types of GaAs varactor diodes both at room temperature and at 40° K indicate excellent results. Author

N65-11331# Bell Aerosystems Co., Tucson, Ariz. Avionics Div.
THE INTERFERENCE PREDICTION MODEL THEORY AND COMPUTER PROGRAMS, REVISION A
May 1963 243 p refs Prepared under subcontract for Pan Am. World Airways
(Contract DA-36-039-SC-80424)
(Rept.-60009-435; AD-447684)

A model that has been developed for simulating communications electronic equipments and their environment on a digital computer is described. All phases of the model are discussed, including the transmitter, receiver, and the scoring and propagation representations from theoretical model equation, and programing viewpoints. Appendixes include detailed equation derivations, and computer flow diagrams and programing information. M.P.G.

N65-11398# Goodyear Aerospace Corp., Akron, Ohio
ADVANCED ANTENNA DESIGN TECHNIQUES Final Report, 1 Jun. 1962–30 Sep. 1963
D. D. Collins and J. C. Bell, Jr. 11 Oct. 1963 331 p refs *Its* Rept.-No. 4
(Contract DA-36-039-SC-90746)
(GER-11246; AD-444184)

Space-vehicle antenna systems and ground-based tracking antenna-system parameters were studied, and requirements were established as design goals. Various types of antenna configurations were investigated to meet the established requirements. Those concepts appearing most desirable for meeting these requirements were evaluated and compared. Selection for further study was made to determine the three most promising concepts consisting of one space antenna and two ground-based antennas. Detail design, structural aspects, and performance for the three selected antennas were studied. New material applications were investigated, and new manufacturing techniques were developed. Design and fabrication of three models and evaluation of these to demonstrate the feasibility of the selected concepts are described. Author

N65-11399# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
RADIATION PATTERNS FROM A SLOTTED CYLINDER SURROUNDED BY A PLASMA SHEATH
T. M. Smith 14 Sep. 1964 27 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-172; TDR-269(4280-10)-6; AD-450118)

A slotted-cylinder microwave antenna, surrounded by a thin plasma sheath that is located an arbitrary separation distance from the cylinder, is examined both theoretically and experimentally. Results are presented to demonstrate the effects of electron density, collision frequency, and separation distance on the antenna patterns. A grid of wires is used to simulate the thin plasma sheath in the experimental investigation. Experimental results obtained in this way verify the agreement between theory and experiment. Author

N65-11414# New York U., N.Y. Lab. for Electroscience Research
A NOTE ON M-ARY SIGNALLING IN THE PRESENCE OF ADDITIVE INTERSYMBOL INTERFERENCE AND NOISE Seventh Scientific Report
Burton R. Saltzberg and Ludwik Kurz Jul. 1964 64 p refs *Its* Tech. Rept.-400-97
(Contract AF 19(604)-6168)
(AFCRL-64-656; AD-450640)

This paper treats the design of M-ary signalling alphabets for transmission over a channel disturbed by additive white gaussian noise, with memoryless correlation detection. The requirements of partial or total bandwidth limitations are considered. Totally bandlimited signals are constructed that lead to low error probability due to the combined effects of intersymbol interference and noise. A minimax criterion is used; namely, the probability of error for the most adverse message sequence is minimized. The signals are constrained so that their amplitudes remain bounded for any message sequence. Signals meeting these requirements are designed as a linear combination of prolate spheroidal functions. Hypercube coding and one-dimensional coding of M-ary alphabets are treated. Author

N65-11444*# Consultants and Designers, Inc., Arlington, Va.
ON THE PROPAGATION OF METER WAVES IN THE INTERPLANETARY SPACE [O RASPROSTRANENII METROVYKH RADIOVOLN V MEZHPLANETNOM PROSTRANSTVE]
M. A. Kolosov, O. I. Yakovlev, A. I. Yefimov, K. M. Shvachkin, and Yu. K. Rozgon 16 Nov. 1964 9 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 9, no. 10, Oct. 1964 p 1735–1739
(Contract NAS5-3760)
(NASA-TT-F-8993; ST-RA-RWP-10241) OTS Prices: HC $1.00/MF $0.50

This paper presents data on the propagation of radio waves to 50 million km distances in the frequency of 183.6 Mc/sec. The maximum possible radio wave attenuation in interplanetary space is estimated. A compilation is given of literature data on the propagation of radio waves in interplanetary space. Author

N65-11486# Naval Ordnance Lab., Corona, Calif. Research Dept.
SOME CALCULATIONS OF TARGET TEMPERATURES IN MICROWAVE RADIOMETRY
John O. Hopper and James W. Battles 15 Mar. 1963 114 p refs
(NAVWEPS-8140; AD-402618)

Calculations of the radiometric temperature differences between various targets and backgrounds have been performed, and the results are presented in graphical form. In addition, an analysis is made of the effects of the varying target, radiometer system, and weather parameters on the detectability of targets. The data indicate that variable-area targets, such as roads and rivers (especially rivers), will be detectable from very high altitudes during all weather conditions considered. Constant-area targets, such as military tanks and aircraft, will be detectable at much lower altitudes or ranges, unless the area of the target is very large. Author

N65-11487# Southwest Research Inst., San Antonio, Tex.
USE OF THE BEVERAGE ANTENNA IN WIDE APERTURE HIGH FREQUENCY DIRECTION FINDING. PART II: SYSTEM DESIGN Interim Report, 4 Mar.–3 Jun. 1964
Douglas N. Travers, Paul E. Martin, and W. M. Sherrill 1 Aug. 1964 78 p refs
(Contract NObsr-89345)
(AD-445116)

Extensive operational tests and measurements have been performed on a circular array of Beverage antennas with the solid state commutator. Several experimental antenna pattern studies have been made using the AN/FRD-10(X-2) Channel Watcher D/F set and the commutator. Many experimental patterns and related tests have been completed and compared to theoretically predicted results. Consistent agreement indicates that the mathematical model of the Beverage antenna can be accepted with confidence for both azimuth and elevation patterns. The effects of horizontal polarization upon the apparent azimuthal angle-of-arrival of a signal have been investigated in some detail. Additional theoretical studies have been made to investigate optimum arraying techniques (including external phasing) for circular arrays of Beverage antennas having a large inner radius compared to the element length. Author

N65-11496*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
BAKER-NUNN PHOTOGRAPHY OF THE SYNCOM II FOURTH-STAGE IGNITION. TRACKING OF CENTAUR (AC-2)
Robert Citron and Leonard H. Solomon 25 Jun. 1964 39 p refs
(Grant NsG 87/60)
(NASA-CR-59543; SAO Special Rept.-156) OTS Prices: HC $2.00/MF $0.50

The film gave values, within ±4 seconds, of ignition time, duration, and burnout time. The unexpected brightness of the actual burn prevented greater accuracy, but the fact that it was easily filmed indicates that the Baker–Nunn system is capable of recording most rocket maneuvers in cislunar space. Author

N65-11504# Lincoln Lab., Mass. Inst. of Tech., Lexington Electronic Systems Div.
RADIO PHYSICS Division 3, Quarterly Progress Report, 1 May–31 Jul. 1964
J. W. Meyer and M. A. Herlin 15 Aug. 1964 13 p
(Contract AF 19(628)-500)
(ESD-TDR-64-364; AD-446691)

This is a progress report on surveillance techniques for the following programs: "Millstone Hill"—system improvement, and programs; "Haystack"—antenna system tests, ground system electronics, radiometer rf box, and radar-communications rf box; "Radio Propagation"—radar echoes from the planet Venus, and computer programs for data analysis. G.G.

N65-11521# Georgia Inst. of Tech., Atlanta Engineering Experiment Station
ELECTRONIC EQUIPMENT INTERFERENCE CHARACTERISTICS—COMMUNICATION TYPE Quarterly Report No. 5, 15 Feb.–15 Jul. 1964
C. W. Stuckey, R. D. Trammell, Jr., and E. W. Wood 15 Jul. 1964 94 p refs
(Contract DA-36-039-AMC-02294(E))
(Rept.-26; AD-448299)

Systems tests have been made on a wideband FM system, utilizing a multiplexer that employs pulse code modulation. To evaluate the system in a PCM environment it was necessary to provide pulse modulation simulating that which will be used by the multiplexing equipment. This was achieved by modulating the transmitter with a continuous binary pulse train at the pulse repetition frequency (PRF) of the multiplexer. The pulses consisted of alternate zeros and ones. The system performance under various interference conditions was measured by an error detection system that determined the total number of transmitted pulses received incorrectly. The techniques of predicting the spectrum signature of cavity-crystal receivers are presented, and the results of an experimental prediction on a typical military receiver are reported. Author

N65-11526# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Avionics Lab.
THIRTEENTH ANNUAL SYMPOSIUM: USAF ANTENNA RESEARCH AND DEVELOPMENT PROGRAM
[1963] 580 p refs Conf. Sponsored by AF Avionics Lab. in cooperation with Ill. U., Monticello, Ill., 14–18 Oct. 1963 (AD-421483)

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N65-11527# Dynatronics, Inc., Orlando, Fla.
BROADBAND ANTENNA FEEDS FOR ARIS TELEMETRY SYSTEM
E. P. Valkenburg and J. C. Pullara *In* AFSC 13th Ann. Symp. USAF Antenna Res. and Develop. Program [1963] 20 p refs (See N65-11526 02-07)

The antenna feed systems described in this paper were designed and developed to satisfy the broadband telemetry tracking requirements of two Advance Range Instrumentation Ships (ARIS). The ARIS telemetry antenna system is capable of autotracking and collecting the data at any frequency in the bands of 215 to 1000 Mc/sec and of 12.5 to 14.5 Gc/sec. Two independent conically scanned feed systems are provided to illuminate the 30-ft-diameter solid reflector. The broadband feed is supported at the focal point of the dish by an octapod spar configuration, whereas the Ku-band feed is located at the vertex of the parabolic reflector. Both feeds are

conically scanned at 1200 rpm to produce a 20-cycle error signal required to provide a tracking performance compatible with the high angular acceleration capability of the telemetry antenna of 30 degrees per second. The design philosophy employed in the rf development of each of the feeds is described, and the performance of each feed when installed in the 30-ft reflector is presented. D.E.W.

N65-11528# Radiation, Inc., Melbourne, Fla.
A BROADBAND CONICAL SCAN AUTOMATIC TRACKING ANTENNA SYSTEM
L. R. Young, C. A. Lovejoy, and L. E. Williams *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 17 p ref (See N65-11526 02-07)
(Contract N-123(61756)32597A)

A broadband antenna system that utilizes an array of four parabolic reflectors with log periodic feeds was adapted for automatic tracking using conical scan techniques. Variable phase shifters were developed that produce essentially a constant differential phase shift over a frequency band of 2:1 or more. These noncontacting phase shifters consist of a combination of both low- and high-pass constant K filters with variable LC elements. For a given variation in L and C, the relative phase shift of the low-pass filter increases with frequency, whereas the high-pass phase shift decreases with frequency in the pass band. With proper design a differential phase shift of about ±25° can be obtained over a 2:1 frequency band with a VSWR of less than 2:1. Calculated and measured performance data are given for both the phase shifters and the antenna systems utilizing the phase shifters. Author

N65-11529# Illinois U., Urbana Antenna Lab.
LOG-PERIODIC CAVITY-BACKED SLOT ANTENNA
V. A. Mikenas and P. E. Mayes *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 15 p refs (See N65-11526 02-07)
(Contract AF 33(657)-10474)

It was found that the design of a log-periodic cavity-backed slot antenna could be successfully based upon considerations of the dual of the equivalent circuit of the log-periodic dipole array. However, since the duality process gives little or no insight into cavity or cavity-loop-coupling behavior, these latter factors added to the complexity of the design of the total structure. It was found, nevertheless, that properties of a single cavity and loop coupling system could be successfully applied to the cavity array, yielding improved performance. D.E.W.

N65-11530# General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
MUTUAL COUPLING EFFECTS IN PHASED ARRAY ANTENNAS
Charles C. Allen *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 42 p refs (See N65-11526 02-07)

This paper presents the initial results of a program for investigating mutual coupling effects, devising means for their reduction, and developing general array design relationships. A 7 X 7 array of dielectrically loaded circular-waveguide horn radiators with an adjustable ground plane was constructed for operation at S band, and measurements were then made of the coupling between radiating elements, the element VSWR, and the element pattern in its array environment as functions of the ground plane position and frequency. The approach used in making these measurements was to excite the central element of the array with all other elements terminated in matched loads. From the data obtained with this approach, the performance of a much larger array of like elements can be determined on a digital computer by a superposition formulation similar to that discussed in a published analysis. A general discussion of the approach used, the related array concepts, and the aim of the overall program is given. The results of measurements on the waveguide horn array are presented. D.E.W.

N65-11531# Michigan U., Ann Arbor Cooley Electronics Lab.
COUPLING EFFECTS WITH SLOT AND SPIRAL ANTENNAS
R. M. Kalafus, R. B. Harris, Y. K. Kwon, and J. A. M. Lyon *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 27 p refs (See N65-11526 02-07)
(Contract AF 33(657)-8178)

For most situations encountered in practice, coupling and interference effects with flush antennas can be evaluated in terms of the far-field patterns along the ground plane. The coupling between slots is highly predictable and uniform due to its simplicity. The spiral coupling has several secondary causes affecting it, characteristics of antennas of its class. In spite of its seeming near-circular symmetry, wide variations in the coupling pattern occur. These variations are associated primarily with the current distribution, and are sensitive to changes in the feed current phase. Standing-wave effects affect the coupling pattern as well, and direct radiation from the cavity and balun plays a significant role at some frequencies. However, the coupling level is largely determined by the distribution of energy associated with the idealized axial mode. D.E.W.

N65-11532# Westinghouse Electric Corp., Baltimore, Md. Electronics Div.
MINIMUM ENERGY ANTENNA PATTERNS
Harold C. Hiscox *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 40 p refs (See N65-11526 02-07)

With the assumption that random noise sources are distributed uniformly in a domain containing the antenna, a criterion that minimizes the antenna-contributed noise is derived. Using this criterion, the aperture illumination pattern is derived, and the resulting antenna patterns are plotted. In order to depress the near-in side lobes of the antenna patterns, a slightly modified derivation of the illumination pattern is used. Antenna patterns resulting from this modified derivation are plotted. An analysis of the antenna pattern variations caused by random phase and amplitude errors in the illumination pattern is made. Tables of illumination amplitudes corresponding to various antenna pattern peak-to-worst-side lobe ratios are given. D.E.W.

N65-11533# Scientific-Atlanta, Inc., Atlanta, Ga.
ANTENNA POLARIZATION ANALYSIS BY AMPLITUDE MEASUREMENT OF MULTIPLE COMPONENTS
L. Clayton and J. S. Hollis *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 28 p refs (See N65-11526 02-07)

A method is described for determining completely, including sense of rotation, the polarization characteristics of an antenna by relative gain measurements only. The method permits rapid recording of polarization data without the requirement for phase-measuring or continuous polarization-scanning equipment. It is ideally suited for use with a radiation-distribution printer and associated punched-tape instrumentation for computer analysis of polarization data describing space-vehicle and airborne antenna characteristics over the sphere. D.E.W.

N65-11534# Illinois U., Urbana
LOG-PERIODIC HELICAL DIPOLE ARRAYS
D. T. Stephenson and P. E. Mayes *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 22 p refs (See N65-11526 02-07)
(Contract N-123(953)-30508A)

The low-frequency cutoff of the logarithmically periodic dipole array occurs when the length of the longest dipole is approximately one-half wavelength. For applications in and below the high frequency (3-30 Mc) band the antenna becomes quite large. By replacing the linear dipoles with normal-mode helical elements, the dipole length can be reduced. Near-field measurements show the similarity in propagation constants in arrays of linear and helical elements. Data are shown for LP helical dipole arrays with elements of length $\lambda/4$ at the lowest frequency. Frequency-independent backfire patterns are maintained, and maximum VSWR less than 2:1 has been achieved. Author

N65-11535# Advanced Development Labs., Inc., Nashua, N.H.
OCTAVE BANDWIDTH MULTIPLE BEAM ARRAY
Martin E. Mehron *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 12 p refs (See N65-11526 02-07)
(Contract AF 33(657)-8896)

This paper presents the results of a program to develop an 8-element/8-beam phased array capable of operating over the octave band of 2 to 4 Gc/sec, for potential use on aircraft and satellites. Because of this potential use, the matrix was fabricated in strip line in order to minimize weight and volume. Also, the antenna elements and beam-forming matrix were designed as a single integrated unit to obviate the necessity for connectors and cables. Subjects of discussion include the operating principles of a multiple-beam-forming matrix, the actual development effort, the test results, the amplitude and phase distributions, and the computed beam patterns. D.E.W.

N65-11536# North American Aviation, Inc., Columbus, Ohio
ARRAY FACTORS WITH ZONE-PLATE SPACINGS
A. J. Mony and R. M. Hoge *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 7 p refs (See N65-11526 02-07)

The zone-plate method of designating sources to be removed from a uniform lattice was found to provide space factors of symmetric linear and planar arrays, with substantial reduction in number of elements required and with no significant deterioration of side-lobe structure. The small variation in side-lobe patterns shows that the number of rings in the reference zone plate is not critical. The method is well adapted to high-speed digital computation. D.E.W.

N65-11537# Illinois U., Urbana Antenna Lab.
A 500:1 SCALE MODEL OF WARLA—A WIDE APERTURE RADIO LOCATION ARRAY
J. W. Greiser and G. S. Brown *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 39 p refs (See N65-11526 02-07)
(Contract NObsr-85243)

This paper describes the design, construction, and testing of a microwave scale model of a circular array of broadband antennas. The ultimate goal of this work is the construction of a high-gain direction-finding array using frequency-independent antennas that would permit efficient operation over the 2- to 32-Mc range. The scale model is an attempt to experimentally verify certain theoretical results that were obtained from calculations performed on a computer. Restrictions imposed on the array by the necessity of keeping interelement phase center spacings less than approximately 0.75 wavelengths have forced the use of three sets of log-periodic elements, one set being added for each higher frequency band. The model discussed represents only the lowest frequency band of the full array. A scaled frequency range of 1000 to 2500 Mc (array diameter of 29 in.) which corresponded to the 2 to 5 Mc range (array diameter of 1210 ft) was employed as the model frequency limits. Typical radiation patterns of the model are presented, and their relation to computed patterns are discussed. Author

N65-11538# Ohio State U., Columbus Antenna Lab.
A TRANSISTORIZED BEAM-CONTROL ARRAY
John R. Copeland, William J. Robertson, and Robert G. Verstraete *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 15 p (See N65-11526 02-07)
(Contract AF 33(657)-10386)

A four-element array of transistorized dipole antennafiers was used for electronic-beam shaping. An equal-amplitude corporate feed was used, but the effective amplitude taper was controlled by circuit gain adjustments on the individual antenna-circuit integrated elements. Patterns were taken with various amplitude distributions, such as uniform, edge, binomial, and Dolph–Chebyshev. The antennafier element used was a gamma-matched half-wave dipole integrated with a 2N1742 vhf transistor amplifier. Adjustable base bias was used for gain control. Up to 12-dB circuit gain was obtainable in each element, with an effective overall noise temperature under 400° K at 148 Mc. Author

N65-11539# Kaman Aircraft Corp., Colorado Springs, Colo. Nuclear Div.
CURRENT DISCONTINUITY DEVICES
Burt J. Bittner *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 9 p (See N65-11526 02-07)

A graph of the radiation pattern from the wave-trap concept is given. This device functions properly as a wave trap when placed at a desired current maximum, as opposed to parallel resonant wave traps that must be placed at voltage maxima. The plot of admittance of a specific tunable current discontinuity band-reject, band-pass filter design is illustrated. Theoretical analysis of the device indicates that there are no transcendental or harmonically related spurious-response characteristics of significance. D.E.W.

N65-11540# Michigan U., Ann Arbor
FERRITE LOADED-SLOT AND TRAVELING-WAVE ANTENNAS
A. T. Adams, J. A. M. Lyon, and J. E. Herman *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 31 p refs (See N65-11526 02-07)
(Contract AF 33(657)-10607)

This presentation summarizes some of the results of a theoretical and experimental investigation of the use of ferrite materials in various types of antennas. Promising results were obtained with a rectangular-slot antenna backed by a ferrite-loaded cavity. Preliminary results were obtained with equiangular spirals using ferrite materials. The work with slots was analytical, with substantial experimental confirmation. So far, the work with spirals has been almost entirely experimental. Author

N65-11541# Ohio State U., Columbus Antenna Lab.
ANALYSIS AND DESIGN OF TUNNEL-DIODE-LOADED DIPOLE ANTENNAS
Kyohei Fujimoto *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 14 p refs (See N65-11526 02-07)
(Contract AF 33(657)-10386)

Tunnel-diode-loaded dipole antennas were studied. Various configurations were used to facilitate matching and to optimize the placement of a tunnel-diode amplifier in the dipole. The combined antenna and amplifier is called an antennafier. The analysis is based on an equivalent circuit of the loaded dipole that can be obtained by decomposing the loaded dipole antenna into a radiating component and a nonradiating component. Using the equivalent network, antennafier properties such as gain, noise performance, etc., can be obtained. Four types

of antennafiers, differing in the location of the tunnel diode loading, are analyzed and design considerations are discussed. Author

N65-11543# Collins Radio Co., Dallas, Tex.
HARDENED ANTENNAS FOR ATLAS AND TITAN MISSILE SITE COMMUNICATIONS
D. H. Holzschuh *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 7 p (See N65-11526 02-07)
(Contract AF 04(694)-132)

Antennas were designed to withstand extreme environments combining high nuclear and thermal radiation with high dynamic effects accompanying nuclear blasts. Performance and electrical requirements are summarized, and the designs are described. D.E.W.

N65-11544# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A PROGRESS REPORT ON 2000° F ANTENNA ELEMENTS
J. J. Earshen and R. J. Blum *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 8 p (See N65-11526 02-07)
(Contract AF 33(657)-11100)

Characteristics required of antennas are listed; an antenna development program is described; instrumentation for testing is discussed; and a material-investigation program is outlined. Progress includes the development of several high-temperature antenna configurations to be tested, the development of high-temperature testing instrumentation, and the formulation and compilation of materials data necessary for high-temperature antenna design. D.E.W.

N65-11545# Emerson and Cuming, Inc., Canton, Mass.
DIELECTRICS FOR ANTENNAS
Eino J. Luoma and David J. Epstein *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 10 p refs (See N65-11526 02-07)

The use of dielectrics in antennas is briefly surveyed; the properties of presently available dielectrics as related to antenna applications are examined; and new special dielectrics for use in antenna design are suggested. Specific topics of discussion include dielectric applications in antennas, dielectric properties and operating temperatures, dispersive dielectrics, artificial dielectrics, anisotropic dielectrics, homogeneity, measurement techniques, and dielectric powders. D.E.W.

N65-11546# Lockheed-California Co., Burbank
CORONA AND BREAKDOWN AS A FUNCTION OF HUMIDITY AT LOW AIR-PRESSURE
Paul F. Stang *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 12 p (See N65-11526 02-07)

The supersonic transport currently under study will cruise at 85 000 feet and will be equipped with hf SSB transceivers of 1-kw power output. Reliable communication is tied to the prevention of corona or voltage breakdown at the antenna. Breakdown measurements were found to be largely affected by the degree of humidity either present or deliberately injected into the rarefied atmosphere. An increase of breakdown potential was observed by other investigators when percentage of humidity was increased at ambient air pressure. This effect was found to depend on gap spacing at dc and ac (50 cps). At hf the breakdown potential is found to be a function of electrode configuration also. Author

N65-11547# McDonnell Aircraft Corp., St. Louis, Mo. Space and Missile Div.
IONIZATION ENHANCED ANTENNA VOLTAGE BREAKDOWN
C. A. Hinrichs *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 18 p refs (See N65-11526 02-07)

The concepts and parameters of voltage-controlled breakdown are reviewed, and the significance of the collision frequency is shown. The importance of the energy-dependence term defining collision frequency is illustrated. A heuristic development relates the gas conditions within and without the breakdown region. When the energy dependence of the collision frequency is incorporated into the basic breakdown expression and when the gas conditions are related, the breakdown function is uniformly lowered as the ambient ionization level is increased, thereby yielding first-order agreement with experimental data. Author

N65-11548# Litton Systems, Inc., Silver Spring, Md. Radcom Div.
C-BAND BEACON ANTENNAS FOR PROJECT APOLLO
W. O. Puro and F. X. Linder *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 7 p Prepared under subcontract for N. Am. Aviation (See N65-11526 02-07)

Phases of the mission and alternative plans, such as aborts, are reviewed for Apollo, and antenna requirements for the manned spacecraft are discussed. A brief statement of the electrical requirements for each of the antennas is given, and a design that uses a fused quartz window is described. D.E.W.

N65-11549# Martin Co., Denver, Colo. Aerospace Div.
UHF CROSSED-SLOT ANTENNA AND APPLICATIONS
W. L. Snow Sep. 1963 *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 17 p refs (See N65-11526 02-07)

Printed circuit methods are used to develop a circularly polarized, crossed-slot antenna whose radome contains all necessary elements. A hybrid junction of balanced strip line is built into the radome and connected to two microstrip, dual-probe feeds. Each dual probe excites one of the two slots and isolates the slots from each other by the symmetrical probe location. Right- or left-hand circular polarization can be obtained by connecting to the respective hybrid junction input port. Pattern beamwidths with regard to circular and linear polarization are 130° and 160°, respectively. The operating bandwidth for a VSWR maximum of 2:1 is approximately 44%. The operating bandwidth, limited by a 50% efficiency and 2.5 dB axial ratio, is approximately 16.8%. Author

N65-11550# Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
A WAVEGUIDE RESONANT RING ANTENNA YIELDING AN OMNIDIRECTIONAL PATTERN
T. E. Charlton, E. R. Murphy, and J. W. Pool *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 20 p refs (See N65-11526 02-07)

A waveguide resonant ring antenna many wavelengths in diameter is described that yields an omnidirectional pattern. The waveguide ring is fed by a T-junction so that equal waves are launched in clockwise and counterclockwise directions around the ring. Radiating elements are coupled to the waveguide at equal intervals around the ring, and the combination of element coupling, element spacing, ring diameter, and waveguide phase velocity create a resonant effect. Dipole radiators mounted in the waveguide broadwall and probe coupled to the guide are employed. Polarization and elevation plane pattern are controlled by an extension of the sidewalls of the waveguide, thus forming a 360° sectoral horn. This design provides a lightweight antenna that can be flush-mounted upon spherical or cylindrical vehicles such as satellites. The

antenna design and fabrication are discussed, and measured performance is presented. Author

N65-11551# North American Aviation, Inc., Los Angeles, Calif.
B-70 ANTENNA SYSTEM
E. Donald Wegner *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 15 p (See N65-11526 02-07)
(NA-63-917)

The environmental conditions of the B-70 led to the need for an antenna development effort. A program that analyzed the structural, thermal, aerodynamic, and electrical performance requirements, in order to obtain a practical and economic balance of these requirements, minimized the necessary development. A survey of state-of-the-art developments proved successful in several areas where existing technology was upgraded to produce a design that met the new XB-70 needs. The use of both testing and analysis in combination allowed a reduction in the overall test program. D.E.W.

N65-11552# Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
AN S-BAND CONICAL SPIRAL ANTENNA FOR SPACE VEHICLE APPLICATION
R. J. Eckstein *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 16 p refs (See N65-11526 02-07)

An antenna is described that was designed for use with the spaceborne transponder of the Goddard range and range-rate tracking system. The tracking system uses carrier and side-tone modulation measurements to determine the exact position of a spacecraft to within a few feet, and its velocity to within fractions of a foot per second. The antenna is a conical spiral radiator supported on a fiberglass cone less than 4.5 in. tall; it weighs less than 0.3 lb; and it is designed to perform at frequencies near 1700 and 2300 Mc/sec. D.E.W.

N65-11553# Sylvania Electric Products, Inc., Waltham, Mass. Sylvania Electronic Systems-East
AUTOMATIC CALIBRATION SYSTEMS FOR TRACKING RADARS
Leonard Blaisdell *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1964] 14 p (See N65-11526 02-07)

The calibration of the electric boresight axis of a radar with scanning capability is considered. The problem is divided into two parts—collecting the calibration data for the error between the electrical and mechanical axes, and using the data in the dynamic situation to correct the indicated target position in real time. An automatic calibration system is described that represents a practical solution to both parts of the problem. D.E.W.

N65-11554# Republic Aviation Corp., Farmingdale, N.Y. Engineering Div.
BORESIGHT ERRORS IN THE NEAR FIELD OF A MONOPULSE ANTENNA
Peter R. Zuzolo, Stanley J. Jurczak, and Joseph A. Castrigno *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 21 p refs (See N65-11526 02-07)
(Contract AF 33(600)-40838)
(RAC-1725)

Measurements were made on a four-horn phase comparison monopulse X-band antenna. This permitted accurate determination of the apparent shift in the elevation channel null as a function of test antenna separation. These boresight errors were determined at a 125-foot free-space boresight range. Antenna separation was successively reduced from the 125-foot maximum (far field) to 6 feet (near field). Therefore, the monopulse antenna was checked in the Fraunhofer, Fresnel, and near field regions. The accepted far field distance criteria for boresight measurements is $D^2\lambda^{-1}$ which in this case is 38.4 feet. Similar data were taken utilizing an anechoic chamber with a maximum antenna separation of 50 feet. The test measurement accuracy varied from 0.09 milliradians at 125 feet to 0.8 milliradians at 6 feet. The data indicate that boresight errors increase with decreasing antenna separation and with increasing elevation angle. The data from the anechoic chamber relative to the free space range also indicate that the boresight errors increase with increased reflections. Author

N65-11555# Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
THE SOLUTION FOR ANTENNA ARRAY INPUT IMPEDANCE BY THE METHOD OF SYMMETRICAL COMPONENTS AND AN ALTERNATING CURRENT NETWORK CALCULATOR
Jack W. Pool *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 21 p refs (See N65-11526 02-07)

This paper represents the equations of arrays of thin linear antennas by an equivalent electrical network, and the input impedance of each antenna in the array is derived, using the method of symmetrical components. The solution of these equations involves the use of a special-purpose analog computer, which had been used extensively in the solution of electrical power-system problems involving the use of symmetrical components. It is concluded that there is a small difference in some instances between the measured and the calculated values of input impedance. D.E.W.

N65-11556# Melpar, Inc., Falls Church, Va.
HYDROACOUSTIC SIMULATION OF ANTENNA RADIATION CHARACTERISTICS
M. L. Parker, Jr., W. A. Meyer, and H. J. Hewitt (RADC, Rome, N.Y.) *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 18 p refs (See N65-11526 02-07)
(Contracts AF 30(602)-2295; AF 30(602)-2735)

The results of the investigation of hydroacoustic modeling indicate that hydroacoustic techniques can be used successfully to simulate the radiation patterns of antennas if small-scale models are employed at frequencies where instrumentation is simplified. Methods for the construction of useful and reliable test facilities and transducers were developed. A number of techniques for the synthesis of antenna-radiation patterns were investigated. D.E.W.

N65-11558# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON POSSIBILITY OF DIRECTION OF BALLISTIC AND GUIDED ROCKETS
Yu. A. Ivanov and B. V. Tyapkin 22 Apr. 1964 14 p Transl. into ENGLISH from the book "Infrakrasnaya Tekhnika v Voyennom Dele" Moscow, Izd. "Sovetskoye Radio", 1963 p 285–292, 357–359
(FTD-MT-64-121; AD-605876)

The operational ranges of atomic charges with an average trotyl equivalent, and their detection through the use of infrared equipment are discussed. Infrared systems are evaluated as an important source for obtaining information on rocket approaches, and also to guide the antirocket rockets on a proper collision course. It is proposed to supply the antirocket missiles with thermal homing devices that lock onto the high temperatures generated by the intruding missiles' nose cones. G.G.

N65-11569# General Electric Co., Oklahoma City, Okla. Electronics Lab.

RESEARCH ON DEVICES FOR THE DETECTION OF WEAK SIGNALS Final Report, Jul. 1963–Jun. 1964

N. R. Powell and R. W. French Wright-Patterson AFB, Ohio, AF Avionics Lab., Sep. 1964 82 p

(Contract AF 33(657)-11369)

(AL-TDR-64-224; AD-605948)

This report contains the principal results of a study of weak-signal communication techniques. The theoretical results obtained during the course of the program, although summarized here, are documented more fully in the first two previous reports. These results include an evaluation of the communications potential associated with a typical time-varying channel, determination of efficient weak-signal detector configurations consistent with such channels, derivation of the threshold performance for one such configuration for phase-feedback controlled parameter demodulation, and an introduction to the design details of an automatic bandwidth-controlled demodulator. The present report contains a detailed description of an implementation of these ideas, along with a summarization of technical results. Author

N65-11593# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ABSORPTION OF RADIO WAVES BY AIR BEHIND A SHOCK WAVE

T. V. Bazhenova and Yu. S. Lobastov 23 Dec. 1963 20 p refs Transl. into ENGLISH from Fiz. Gazodinam., Akad. Nauk SSSR, Energ. Inst. (Moscow), 1962 p 270–274

(FTD-MT-63-74; AD-605883)

Results are given of experiments on the absorption of radio waves ($f = 10^{10}$ cps) in a shock tube by air at temperatures from 2000° to 4000° K. The time of establishment of the equilibrium concentration of electrons was determined, and calculated data on absorption of radio waves were compared. In the zone of unequilibrium dissociation, in which there is an increased temperature and concentration of NO, no increased concentration of free electrons appears, since the time of achievement of the equilibrium concentration of electrons is commensurable with the time of achievement of the equilibrium temperature and composition. Author

N65-11648# New Mexico State U., University Park Physical Science Lab.

DESIGN OF MODEL 2.040 AND 2.041 QUADRALOOP ANTENNAS

D. G. Henry Sep. 1963 17 p ref

(Contract AF 19(628)-3229)

(SR-1; AD-606080)

Two adaptations of the basic quadriloop antenna to make it fit directly on the standard Aerobee rocket 10-in. telemetry extention are described. Model 2.041 is the pressurized version of the unpressurized Model 2.040. Electrical and mechanical characteristics of these antennas are presented, as are assembly and mounting techniques. M.P.G.

N65-11668# Pennsylvania State U., University Park Ionosphere Research Lab.

LECTURE NOTES ON A COURSE ON WAVE PROPAGATION IN INHOMOGENEOUS MEDIA Scientific Report No. 215

O. E. H. Rydbeck 1 Aug. 1964 156 p refs

(Contract AF 19(628)-4014; NSF G-18983)

(AFCRL-64-636; AD-608102)

Some of the more important methods used in analyzing the propagation of waves in inhomogeneous media are discussed. The discussion is concerned with the following general areas: (1) the WKB approximation methods for obtaining reflection and transmission coefficients for simple stratified media; (2) linear combinations of propagating fields, the sum of which satisfies the relevant wave equation; (3) integral methods for obtaining approximate reflection and transmission coefficients for a slowly varying, optically wide medium; (4) application of the Ricatti equation to the solution of symmetrical barrier problems; (5) detailed wave treatment of a lossy, parabolic barrier; (6) the theory of the Epstein profile; (7) general treatment of the nth-order wave equation using coupling methods; and (8) discussion of the physical aspects of the nth-order wave system—development of the generalized transmission (and reflection) coefficients for an arbitrary multiwave system. P.V.E.

N65-11690# Aberdeen Proving Ground, Md. Army Limited War Lab.

ANALYSIS OF BALLOON-BORNE COMMUNICATION SYSTEMS

David W. Samuels Sep. 1964 35 p refs

(TM-64-04; AD-448720)

The purposes of the study were to provide an analytic basis for choosing among different versions of these systems and to provide data for optimizing system design. It is concluded that two-wire transmission lines offer much superior performance to coaxial lines in this application, and a ground radio such as the AN/VRC-12 connected to a balloonborne antenna by a two-wire transmission line is a superior system configuration. It was determined that valuable contributions to system optimization are possible by use of an antenna preamplifier and copper-plated aluminum conductors in the transmission line. Author

N65-11695# Army Missile Command, Huntsville, Ala. Re-Entry Physics Branch

AN APPLICATION OF SELF-PHASING ARRAY ANTENNAS TO THE RADAR DETECTION PROBLEM Detection & Discrimination Monograph 20

John D. Cremin 17 Jul. 1964 22 p refs

(Proj. Defender)

(TR-AMSMI-RNR-64-2)

A system concept is proposed that may reduce the communication and data processing problem by using self-phasing array antennas and a modulation scheme in which the forward (offset) radar transmits its pointing angles via reflection from the target to the main (terminal) site. A comparison of signal to noise ratios for the single terminal radar and the multiple radar case is presented for a particular target and trajectory. The comparison shows the multiple radar system to be superior to the single radar by 15 dB for the particular case chosen. The 15-dB improvement means that to achieve equivalent performance the forward site radar power or sensitivity can be reduced by a factor of 32 over the main site radar. Reductions in performance of this order of magnitude can be directly related to radar equipment cost and size. Author

N65-11719# Microwave Associates, Inc., Burlington, Mass. Solid State Div.

UHF DUPLEXERS SEMICONDUCTOR EFFORT Quarterly Progress Report, 5 May–5 Aug. 1963

Henry Griffin and Sumner Segal 10 Jul. 1963 28 p

(Contract NObsr-89105)

(QPR-3; AD-422329)

A three-port ferrite circulator was developed that is capable of handling 300-kW peak power, 3500-W average power over the band 400 to 450 Mc. Techniques to increase the power handling capability are discussed. Experimental data on a diode limiter are presented that confirm theoretical calculations. By cascading two limiter sections, a balanced limiter can be

achieved that will handle 30-kW peak power, 300-W average power, at a 60μs pulse width. Isolation on the order of 55 dB is possible with an insertion loss of 0.8 dB. Author

N65-11720# Radiation, Inc., Melbourne, Fla. Antenna and Microwave Section
STUDY OF SPECIAL BEAMSHAPING ANTENNAS First Quarterly Report, 1 Jul.–30 Sep. 1963
R. E. Moseley, B. L. Lewis, H. E. Bartlett, and G. W. Collins [1963] 107 p refs
(Contract DA-36-039-AMC-03310(E))
(Rept.-1; AD-423224)

This is a study of a dielectric foam-rod antenna for use in high-gain, lightweight, easily transportable, satellite communications antenna arrays. The end-fire array theory, and the optical-tracing theory were applied to predict the radiation characteristics for this antenna configuration. The relatively poor agreement between theory and experiment in the case of the end-fire array theory was found to be related to the use of wave velocities that apply to infinitely long dielectric waveguides. The tracing theory was used to gain a simple prediction technique for elements of arbitrary shape and their radiation characteristics, and produced encouraging preliminary results. It was found that the element sidelobe levels are controllable through the control of the element's shape and/or its axial amplitude taper. G.G.

N65-11721# Ohio State U. Research Foundation, Columbus Antenna Lab.
A THEORETICAL STUDY OF THE MODIFICATION IN ECHO AREA OF SPACE VEHICLES DUE TO THEIR LOCAL SPACE ENVIRONMENT Quarterly Status Report, 1 Jun.–31 Aug. 1964
1 Sep. 1964 7 p refs
(Contract AF 19(604)-7270)
(Rept.-1116-52; AD-447526)

Progress is reported in determining the change in echo area of a satellite caused by a plasma sheath and determining the extent and duration of satellite-induced ionization. Methods used to determine the cause of propagational phase variations in the very-low-frequency range are discussed, and some preliminary results of a typical analysis are given. Author

N65-11751# Mitre Corp., Bedford, Mass.
PHASE AND ENVELOPE OF LINEAR FM PULSE-COMPRESSION SIGNALS FROM HIGH-VELOCITY TARGETS
M. H. Ueberschaer Nov. 1964 56 p refs
(Contract AF 19(628)-2390)
(TM-03916; ESD-TDR-64-128; AD-608056)

Equations for the phase and envelope of the output signal from a linear filter, matched to the transmitted signal, are derived. The transmitted signal is assumed to have a flat band–limited amplitude spectrum and a linear group delay. The input to the matched filter is the radar echo returned from a moving target whose velocity is essentially constant during the illumination time. It is shown that the returned signal is related to the transmitted signal by a time dilation. The resulting expressions for the phase and envelope are functions that involve Fresnel integrals. Approximations for these expressions are worked out. They are shown to be similar in form to those that are obtained when the returned signal is assumed to be related to the transmitted signal by a doppler shift. Author

N65-11790# Pennsylvania State U., University Park Ionosphere Research Lab.
THE MEASUREMENT OF PHASE AND AMPLITUDE RADIO WAVE INTERACTION AT UNIVERSITY PARK, PENNSYLVANIA, FOR APRIL-MAY-JUNE, 1964
Anthony J. Ferraro and Hai Sup Lee 1 Sep. 1964 60 p refs
Its Sci. Rept. No. 224
(Contract AF 19(628)-4014; NSF GP-846)
(AFCRL-64-824; AD-607686)

The results of the measurement of phase and amplitude radio-wave interaction are reported. The objective of the work was to study the properties of the ionospheric D-region using the radio-wave interaction effect, also commonly known as the Luxembourg effect. Radio-wave interaction is explained; the experimental details are given; and equations forming the basis of measurement are derived and clarified. Data are presented, by date and time, for the height at which the downcoming wanted signal meets the upgoing disturbing signal, for the fractional change in the amplitude of wanted signal due to radio-wave interaction, and for the differential change in the phase of wanted signal due to radio-wave interaction. D.E.W.

N65-11826# Ohio State U. Research Foundation, Columbus Antenna Lab.
PROCEEDINGS OF THE OSU-RTD SYMPOSIUM ON ELECTROMAGNETIC WINDOWS, 2–4 JUNE 1964, VOLUME I
Alan I. Slonim, comp. [1964] 104 p refs Seventh Symp. held at Ohio State U.
(Contract AF 33(615)-1081)
(AD-605390)

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SESSION II: MATERIALS FOR HIGH TEMPERATURE APPLICATIONS
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5. SILICON NITRIDE AS A HIGH-TEMPERATURE RADOME MATERIAL W. M. Wells 17 p refs (See N65-11831 02-07)

N65-11827# Raytheon Co., Waltham, Mass. Research Div.
CHEMICALLY VAPOR DEPOSITED BORON NITRIDE
P. C. Li, A. J. Capriulo, and M. P. Lepie *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. I [1964] 21 p refs (See N65-11826 02-07)

The chemical vapor deposition (CVD) of boron nitride results in a unique material that could find application as a superior microwave and infrared window. Process techniques are discussed for hot-pressed and CVD boron nitride. Shortcomings and advantages of both methods are outlined. Data to be presented include microstructure, mechanical, thermal, and electrical properties of CVD material. Like its isomorph, pyrolytic graphite, CVD boron nitride is harder, denser, stronger, and more anisotropic than the conventional material. An extremely low dielectric constant and loss tangent, which is relatively unaffected by temperature change, also make it ideal for microwave windows. No infrared absorption is observed beyond 13μ. Author

N65-11828# Ohio State U. Research Foundation, Columbus
SLOT CLOSURES FOR A 2500°F ANTENNA
W. H. Wheeler, P. M. Winslow, and L. E. Gates *In its* Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. I [1964] 16 p (See N65-11826 02-07)

The program to develop a materials system for a planar antenna designed to operate under a typical glide reentry pattern is described. The most promising system incorporated mullite windows hot pressed into molybdenum waveguide end plates. The diffusion bond developed in this system was enhanced with the use of a thin platinum foil interlayer. A window of this type was found to be helium leaktight after thermal cycling to 2910° F. Electron-beam welding was found to be suitable for fabrication of molybdenum waveguides to specified dimensions, and for welding an end plate containing a ceramic window to waveguide tubing. The molybdenum waveguide containing a mullite window was coated with molybdenum disilicide without serious electrical degradation of the window. D.S.G.

N65-11829# Boeing Co., Seattle, Wash. Aero-Space Div.
THE MEASURED ELECTRICAL CHARACTERISTICS OF SEVERAL ABLATIVE AND SOME NON-ABLATIVE HIGH TEMPERATURE RADOME MATERIALS
T. Larry Norin *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. I [1964] 21 p (See N65-11826 02-07)

The results of X-band electrical tests performed on six ablative materials are presented for evaluation of electrical performance at ambient through ablation temperatures. The materials tested were cork phenolic nylon, Teflon, Duroid, Thermolag, and Avcoat; all these materials except Teflon are reinforced plastics (Teflon is a thermoplastic). The representative maximum attenuation values for the materials were obtained by averaging the absorption losses for each of three samples after a 7-minute exposure time in the high-temperature transmission range. From an electrical-performance standpoint, the noncharing Teflon was considered superior to the char-forming materials; however, the reinforced plastics are more desirable from both the structural and thermal-protection standpoints. D.S.G.

N65-11830# Brunswick Corp., Marion, Va. Defense Products Div.
DEVELOPMENT OF A 1200° F RADOME
Vance A. Chase and R. L. Copeland *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. I [1964] 24 p ref (See N65-11826 02-07)

The program for the development of large, fibrous reinforced, lightweight radomes that will operate in the temperature range of 800° to 1200° F for prolonged periods of time is described. The composite developed is based on an aluminum phosphate matrix and Corning S-994 fiberglass. A protective coating of silicone resin is applied to the glass fabric to prevent its degradation. Laminated structures are obtained at pressures of 100 psi and 30° to 350° F for 1 hour, followed by a postcure at 600° F. The mechanical, thermal, physical, and electrical properties of the glass-reinforced aluminum phosphate laminate are discussed. To demonstrate the feasibility of the material and manufacturing techniques, a 65-inch ogive shape radome was designed and fabricated; the stress analysis performed is described. The major problem areas with the material are strength decrease after thermal aging and tensile-strength reduction at elevated temperatures after short-term exposure. D.S.G.

N65-11831# California U., Livermore Lawrence Radiation Lab.
SILICON NITRIDE AS A HIGH-TEMPERATURE RADOME MATERIAL
William M. Wells 19 May 1964 *In* Ohio State U. Res. Found. Proc. of the OSU-TDR Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. I [1964] 17 p refs (See N65-11826 02-07)
(Contract W-7405-ENG-48)
(UCRL-7795)

Silicon nitride was investigated for application to structural elements in high-temperature, air-cooled reactors. Measurements show that it can easily have values for the two common thermal stress parameters that are substantially higher than those for either alumina or beryllia. In addition, its longtime high-temperature strength (to at least 2700° F) is substantially better than either of these two oxides. Its oxidation resistance is very good. Most of its exceptional thermal stress resistance can be attributed to its low modulus of elasticity and low coefficient of thermal expansion. Actual experience with purchase of the same shape made from both alumina and silicon nitride show that the nitride is the cheaper. Of the properties of silicon nitride that are significant in radome applications, the electrical properties are least known. However, the one available published value of dielectric constant (9.4) seems reasonable. Author

N65-11832# Ohio State U. Research Foundation, Columbus Antenna Lab.
PROCEEDINGS OF THE OSU-RTD SYMPOSIUM ON ELECTROMAGNETIC WINDOWS, 2–4 JUNE 1964, VOLUME II
Alan I. Slonim, comp. [1964] 225 p refs Seventh Symp. held at Ohio State U.
(Contract AF 33(615)-1081)
(AD-605400)

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9. DESIGN AND PERFORMANCE OF 60 FOOT C-BAND RIGID RADOME, CW-424/FPS-26 C. S. Beal (RADC), J. R. Gruber, and D. J. Driscoll (AVCO Corp.) 27 p refs (See N65-11841 02-07)

10. HARDENED GROUND RADOMES FOR SYSTEM SURVIVAL G. J. Cook (North Am. Aviation) 29 p refs (See N65-11842 02-07)

N65-11833# Boeing Co., Renton, Wash. Airplane Div.
SLOTTED METAL RADOME FOR HIGH-SPEED FLIGHT
C. H. Chiou, L. L. Oh, and C. D. Lunden *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. II [1964] 14 p refs (See N65-11832 02-07)

A promising technique has been developed for the construction of fenestrated metal radomes that are transparent to microwaves. Because of unavoidable reflections at an air–metal interface, even the most ingeniously filligreed metal radome will not become perfectly transparent. However, a predominantly metal radome built on these principles should be useful in supersonic aircraft and in applications where strength of metal and microwave transparency are required. It is estimated that such a slotted metal radome will retain 50% of the structural integrity of the solid metal sheet; however, the mechanical strength of the slotted metal was not investigated. If a high-strength-at-high-temperature alloy is used, metal thicknesses of 1/8 to 1/4 inch should be sufficient even at Mach 2 or Mach 3. Author

N65-11834# Sperry Microwave Electronics Co., Clearwater, Fla.
ANTENNA RADOME-GRATINGS FOR CONICAL SCAN SYSTEMS
A. H. Schaufelberger *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. II [1964] 19 p (See N65-11832 02-07)

Power modulation was employed to reduce the low-angle scatter return of vertically polarized conical-scan radars. The suppression of the resulting cross-polarizing component in the radar-system antenna was obtained. A radome-grating configuration, which provided the dual functions of environmental protection of the antenna and rejection of the orthogonally polarized component of the signal, is presented. G.G.

N65-11835# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
WIDE BAND ECM RADOMES ON HIGH PERFORMANCE AIRCRAFT
J. F. Harder and W. P. Guarino *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. II [1964] 36 p refs (See N65-11832 02-07)

This paper discusses a radome program for the housing of sophisticated, wideband-system antennas on a modified production airplane. Observed are the aerodynamic smoothness and stability of the radome shape, the structural limitations of the sandwich design, some multilayer optimization techniques, and the manufacturing of female molds, preimpregnated glass cloth, and the nylon phenolic honeycomb. The static and dynamic antenna patterns were recorded and are presented. G.G.

N65-11836# Ohio State U. Research Foundation, Columbus Antenna Lab.
THE SCANNABLE RAY-FED RADOME
Stephen J. Gotkis *In its* Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. II [1964] 12 p refs (See N65-11832 02-07)

A radome technique is presented for providing a maximum mechanical strength structure, and, at the same time, affording efficient energy-transfer characteristics and a good pattern fidelity. An electromagnetic window is considered, consisting of a dipole array connected to an identical array on the opposing face of a metal sheet by a nonradiating transmission line. Methods for the optimization of the transmission through the integrated antenna–radome are discussed, and a suitable Thevenin equivalent circuit for the calculation of the power transfer for any element in the array has been derived. A prototype model of this integrated antenna–radome has been constructed and is described. G.G.

N65-11837# Republic Aviation Corp., Farmingdale, N.Y. Engineering Div.
AN APPLICATION OF RADOME BROADBANDING
Peter Zuzolo, Chandler Hom, and Stanley Jurczak *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. II [1964] 16 p (See N65-11832 02-07)
(ESD-64-112R)

This paper presents an analysis of radome broadbanding, using a simple A-sandwich design. The electrical properties are examined by the application of an established transmission formula to form the equations containing the Fresnel interface reflection coefficients. It is concluded that the radome must have uniform transmission characteristics throughout most of the azimuth coverage, except in a narrow region of the waveguide runs, in order to meet the electrical requirements. G.G.

N65-11840# Goodyear Aerospace Corp., Akron, Ohio
FEASIBILITY OF MONOLITHIC FOAM RADOMES
George C. Fretz, Jr. *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. II [1964] 20 p (See N65-11832 02-07)

The structural aspects of the required monolith foam radomes were studied in order to establish unit details for electrical evaluation, based on worldwide environmental requirements. The excellent results obtained with 17-ft and 26 1/2-ft monolith foam radomes led to the consideration of their feasibility for larger applications, and after extensive environmental, structural, electrical, and fabrication technique investigations, a 55-ft diameter was chosen for an all-foam radome study, because it is a size that can contain and protect several models of currently existing radars. G.G.

N65-11841# AVCO Corp., Cincinnati, Ohio Electronics Div.
DESIGN AND PERFORMANCE OF 60 FOOT C-BAND RIGID RADOME, CW-424/FPS-26
C. S. Beal (RADC), J. R. Gruber, and D. J. Driscoll *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. II [1964] 27 p refs (See N65-11832 02-07)
(Contract AF 30(635)-19825)

This paper gives a detailed description of a rigid radome to be used with a high-power C-band radar that employs a high-gain nodding antenna to achieve a precise elevation-angle determination on distant targets. An optimum configuration for meeting the conflicting requirements of high rf power transmission and mechanical strength, within a restrictive weight limit, is presented. It was concluded that a sandwich wall-type structure resists the effects of strong winds best, and at the same time permits the operation at C-band with high rf power transmission and a very small beam-axis shift. G.G.

N65-11842# North American Aviation, Inc., Columbus, Ohio
HARDENED GROUND RADOMES FOR SYSTEM SURVIVAL

G. J. Cook *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. II [1964] 29 p refs (See N65-11832 02-07)
(Contract AF 30(602)-2923)

This investigation consists of determining the dynamic response of a thin, uniform-thickness, truncated spherical shell to airblast-induced shock loads. The response analysis includes a failure criterion for determining the vulnerability of this type of structure to nuclear blasts. The structural dynamic characteristics of the radome were represented by the normal mode approach. The mathematical representation of the blast-induced pressure loading was based on published experimental data. Solutions to this mathematical model were obtained from an operational analog computer. Author

N65-11843# Ohio State U. Research Foundation, Columbus Antenna Lab.
PROCEEDINGS OF THE OSU-RTD SYMPOSIUM ON ELECTROMAGNETIC WINDOWS, 2–4 JUNE 1964, VOLUME IV
Alan I. Slonim, comp. [1964] 164 p refs Seventh Symp. held at Ohio State U.
(Contract AF 33(615)-1081)
(AD-605392)

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7. THE USE OF TRAVELING-WAVE STRUCTURES IN INTEGRATED ANTENNA-RADOME DESIGN J. R. Baechle 10 p refs (See N65-11850 02-07)
8. ERROR AND LIMITATION ANALYSIS ON THE MEASUREMENT OF DIELECTRIC PROPERTIES BY USE OF THE SHORTED WAVEGUIDE REFLECTION THEORY AT HIGH TEMPERATURES R. W. Johnston (Douglas Aircraft Co.) 17 p refs (See N65-11851 02-07)

N65-11844# McDonnell Aircraft Corp., St. Louis, Mo. Missile and Space Engineering Div.
HIGH TEMPERATURE TELEMETRY ANTENNAS FOR ASSET
J. W. Krah *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. IV [1964] 19 p ref (See N65-11843 02-07)

The development of two antennas for use on ASSET, a hypersonic glide reentry vehicle, is described; these are the flush-mounted dielectric-loaded U-slot configuration for the vhf telemetry band, and the pressurized "open-ended" waveguide X-band antenna. Although the final vhf antenna performance did not fully meet design objectives, it has proved to be adequate for the data-transmission requirements of the ASSET. The X-band antenna completely satisfied the design objectives. Problems were encountered in testing antenna electrical characteristics at high temperature. Improvements in testing methods and facilities are required. D.S.G.

N65-11846# Sperry Gyroscope Co., Great Neck, N.Y. Radiation Div.
ADVANTAGES OF DUAL WALL RADOME CONSTRUCTION FOR TACTICAL RADAR SYSTEMS
William M. Foster *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. IV [1964] 10 p (See N65-11843 02-07)

The general structural aspects of dual-wall air-inflated structures are presented, and the unique properties of dual-wall radomes used for tactical advantages in the TPS-34 Radar System are discussed in detail. The advantages of the airbeam construction include the following: (1) no limitation on the shape of the radome from top hemisphere to ground; (2) structural rigidity with one 18-ft section deflated and opened; (3) a simple fastener that can quickly and easily connect sections together; (4) provision for rapid inflation during erection; (5) no supplemental structure needed for anchoring; and (6) excellent thermal insulation. The dual-wall construction is heavier and more expensive than the single wall, and may affect electrical performance to a greater extent when used as a radome. D.S.G.

N65-11847# General Dynamics Corp., San Diego, Calif.
MICROWAVE FIELDS NEAR A HOLLOW DIELECTRIC WEDGE AND DIELECTRIC SLAB
G. Tricoles and E. Rope *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. IV [1964] 10 p refs (See N65-11843 02-07)

A description was given of the effects of finite dielectric slabs on propagation of nearly plane microwaves. Measurements showed very deep minima behind the slab. Without the slab, the field was nearly uniform. It was assumed that the minima were produced by interference of a plane wave transmitted through the sheet and a guided wave propagated along the slab. Quantitative predictions were made of spacings of minima by using the propagation constants appropriate for a slab of infinite extent. Even with this idealization, measured and computed spacings agreed within a few percent. Author

N65-11848# General Dynamics Corp., San Diego, Calif.
APPLICATION OF A RAY TRACING METHOD FOR PREDICTING RADOME ERRORS TO A SMALL RADOME
G. Tricoles and D. Gelman (Gen. Dyn./Pomona, Calif.) *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. IV [1964] 29 p refs (See N65-11843 02-07)

A ray tracing method was developed for application to radomes, which are surfaces of revolution defined by von Kármán ogive curves. An approximate description was made assuming the radome to be locally plane. For single-layer radomes, computed and measured transmission agreed moderately well. Discrepancies were polarization dependent, being about 5% for displacement of the antenna in azimuth and by 10% for elevation. Measured transmittance exceeded 1.00 for some angles for elevation displacements. Measured and computed boresight error agreed moderately well for azimuth. For elevation, discrepancies were large, and measured and computed results were qualitatively different. By introducing the hypothesis of a vertex scattered wave, discrepancies were reduced, and correct qualitative agreement was obtained between measured and computed boresight error. Transmittance discrepancies were reduced also. Author

N65-11849# Andrew Corp., Chicago, Ill.
RADOMES FOR MICROWAVE APPLICATIONS
A. G. Holtum, Jr. and E. E. Mc Kee *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. IV [1964] 38 p refs (See N65-11843 02-07)

This paper describes and reviews radomes used for commercial microwave relay antennas. The technical requirements and related electrical and mechanical parameters are reviewed for a variety of radome types. Included are a summary of the design criteria and decisions with which the radome designer must become involved, together with tests, both electrical and mechanical, which are used to evaluate the material and the finished configuration. Attention in the paper includes loss, effect on VSWR, and effect on the radiation pattern of various radome configurations, materials, and material variations. With regard to mechanical aspects, wind, snow, and falling ice are considered. The radomes considered range in size up to 15 ft in diameter and are designed for frequencies from 2 Gc to 12 Gc. Author

N65-11850# Ohio State U. Research Foundation, Columbus Antenna Lab.
THE USE OF TRAVELING-WAVE STRUCTURES IN INTEGRATED ANTENNA-RADOME DESIGN
John R. Baechle *In its* Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. IV [1964] 10 p refs (See N65-11843 02-07)

The effects of curvature on traveling-wave structures are investigated. The investigation is carried out by studying the effects of curvature in the direction of propagation on the wave number of an electromagnetic field propagating over a cylindrical traveling-wave surface. Calculated and experimental data are presented that show the effects of curvature on the wave number and on the electric and magnetic field intensity variations as a function of distance normal to the curved surface. Data are shown graphically for two specific antenna structures, the dielectric clad metal cylinder, and the corrugated metal cylinder. Because of the simplicity of the expressions used, other types of structures may easily be studied either analytically or experimentally, and calculations can be carried out with a minimum of effort on a desk calculator.
Author

N65-11851# Douglas Aircraft Co., Inc., Santa Monica, Calif. Electromagnetic Radiation Lab.
ERROR AND LIMITATION ANALYSIS ON THE MEASUREMENT OF DIELECTRIC PROPERTIES BY USE OF THE SHORTED WAVEGUIDE REFLECTION THEORY AT HIGH TEMPERATURES
Russell W. Johnston *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. IV [1964] 17 p refs (See N65-11843 02-07)

The development of microwave radomes and similar structures, wherein the low-loss transmission of electromagnetic energy is desired, requires the determination of the dielectric constant and the loss tangent. Various major sources of errors and limitations of the shorted waveguide method of determination are examined. The produced error is seen to vary particularly with the precision of mechanical readout, and may be quite high. Also the accuracy of determining the loss tangent depends on the loss characteristics and chosen widths of the samples, and a precise error prediction is not attempted. The dielectric constant may be determined to a higher degree of accuracy; a figure of 5% may be considered to be typical.
D.S.G.

N65-11852# Ohio State U. Research Foundation, Columbus Antenna Lab.
PROCEEDINGS OF THE OSU-RTD SYMPOSIUM ON ELECTROMAGNETIC WINDOWS, 2–4 JUNE 1964, VOLUME V
Alan I. Slonim, comp. [1964] 187 p refs Seventh Symp. held at Ohio State U.
(Contract AF 33(615)-1081)
(AD-605393)

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4. RADOME MATERIALS RESEARCH AT RUTGERS U. E. J. Smoke (Rutgers U.) and C. F. Bersch (Bureau of Naval Weapons) 19 p (See N65-11856 02-07)
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7. DUAL FREQUENCY RADOME FEASIBILITY G. M. Randall and D. F. Zemke (Autonetics, Calif.) 17 p (See N65-11859 02-07)
8. LARGE AIR SUPPORTED RADOMES FOR SATELLITE COMMUNICATIONS GROUND STATION W. W. Bird (Birdair Struct., Inc., N.Y.) 12 p (See N65-11860 02-07)
9. EFFECTS OF APERTURE OBSTRUCTIONS AND RADOME FINISHES UPON RADOME ELECTRICAL CHARACTERISTICS J. R. Rogers (McDonnell Aircraft Corp., Mo.) 28 p (See N65-11861 02-07)
10. MEASUREMENTS OF DYNAMIC COLLIMATION ERROR D. L. Loyet and J. R. Mauer (Hughes Aircraft Co., Calif.) 20 p (See N65-11862 02-07)
11. TECHNIQUE FOR ELECTRICAL EVALUATION OF ELECTROMAGNETIC WINDOW AND RADOME SHAPES F. L. Coling (Budco Engr. Co., Calif.) 9 p (See N65-11863 02-07)

N65-11853# North American Aviation, Inc., Los Angeles, Calif.
ELECTRICAL DESIGN AND PERFORMANCE EVALUATION OF DUAL-FREQUENCY RADOME TEST PANELS
E. Donald Wegner and N. D. Lo Bue *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. V [1964] ref (See N65-11852 02-07)

Dual-frequency radar operation is being considered for applications in high-performance airvehicles to a larger and larger extent as multipurpose vehicles are required. To be successful, good radome electrical performance must be achieved for the frequencies employed. Dual-frequency (X-band and K_2-band) radome-design criteria are presented, as well as how these criteria might be used to obtain the radome-panel designs. The method for calculating the theoretical power transmission and the insertion-phase-delay performance curves is outlined. Also, a test-panel fabrication and laboratory test program is described. D.S.G.

N65-11854# Sperry Gyroscope Co., Great Neck, N.Y. Radiation Div.

TRANSMISSION CHARACTERISTICS OF GROUND BASED RADOMES

J. D'Agostino and F. Rouffy *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. V [1964] refs (See N65-11852 02-07)

The fundamental electrical characteristics of the three basic types of radomes are summarized, and the electrical design parameters are condensed to a series of performance curves. In general, the radome with the best overall electrical properties is the air-inflated radome. For durability, the dielectric (honeycomb sandwich or solid dielectric) radome is best suited for low-frequency operation, while the metal-space-frame radome is best suited for frequencies above its low-frequency cutoff. There is obviously a crossover region where more than one type of radome may satisfy the electrical transmission requirements; the selection then would require a trade-off study between cost factors and structural requirements. D.S.G.

N65-11855# Johns Hopkins U., Baltimore, Md. Applied Physics Lab.

RADOME THERMAL DESIGN FOR A MACH 4 MISSILE

R. P. Suess and L. B. Weckesser *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. V [1964] 15 p ref (See N65-11852 02-07)

In order to select the one missile trajectory that would be most thermally severe, 21 representative trajectories, both ballistic and line-of-sight, were analyzed. The maximum Mach number of the trajectory found to be most thermally severe was considerably below the design number (4.0) of the study; those trajectories achieving Mach 4 were not critical from a radome thermal-stress viewpoint. The radome material selected for the thermal design study was Pyroceram. A thorough temperature and stress analysis was performed on two radomes—one a standard Von Kármán shape and the other a Von Kármán blunted shape with a 1.35-in. radius. Only the extreme forward portion of each radome was analyzed, since this area encompassed the region of maximum thermal stress. Preliminary experimental compressive-stress evaluations and full-scale wind-tunnel tests were performed, and the data were compared with theoretical predictions based on cylindrical- and spherical-shell theories. D.S.G.

N65-11856# Rutgers U., New Brunswick, N.J.

RADOME MATERIALS RESEARCH AT RUTGERS U.

E. J. Smoke and C. F. Bersch (Bureau of Naval Weapons, Washington, D.C.) *In* Ohio State U. Res. Found. Proc. of The OSU–RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. V [1964] 19 p (See N65-11852 02-07)

In the research program on ceramic radome materials, it was found that all industrial impervious high-alumina ceramics contained from 8% to 12% void volume, and that the void volume was not uniform, especially in large specimens. Using the "prereacted raw materials" technique, ceramics can be made to 99% of their true density and provide significant improvement in radar transmission characteristics. In the range of 3000° F and above, the effects of magnesia additions, of firing time, and of temperature in vacuum, and of helium and hydrogen atmospheres on pure alumina were investigated. Minimum conditions under which 1% porosity was attained are given. From 2600° to 3000° F, the technique was applied to various compositions of magnesia–alumina–silica system. To attain high density, it was found that a controlled grinding of the prereacted material was necessary. From 1800° to 2600° F the melting of the complete composition and fabrication of a powdered glass were necessary. D.S.G.

N65-11859# Autonetics, Anaheim, Calif.

DUAL FREQUENCY RADOME FEASIBILITY

Grant M. Randall and Donald F. Zemke *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. V [1964] 17 p (See N65-11852 02-07)

The data presented in the report support the feasibility of designing and constructing a dual-frequency radome. Two radome materials were analyzed, and both were satisfactory. Superior high-temperature performance and better radome transmission can be obtained with the type II material (quartz fabric with silicone resin). Nonmultiples of the dual frequency can be used for radar operation. However, this requires specialized design techniques using a reactive wall concept. This method may give some slight degradation in electrical performance and would probably cost more for fabrication of production radomes. Author

N65-11860# Birdair Structures, Inc., Buffalo, N.Y.

LARGE AIR SUPPORTED RADOMES FOR SATELLITE COMMUNICATIONS GROUND STATION

Walter W. Bird *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. V [1964] 12 p (See N65-11852 02-07)

Three large air-supported radomes, two with a diameter of 210 feet and one with a diameter of 160 feet, have been put into service for periods ranging up to 2 years. These radomes, having generally high rf performance and low cost, prove the practicality of air-supported radomes where superior performance is required. The development of new materials, fabrication techniques, and equipment required for radome manufacture is described. Equipment reliability and the erection of large radomes are also discussed. D.S.G.

N65-11861# McDonnell Aircraft Corp., St. Louis, Mo. Aircraft Engineering Div.

EFFECTS OF APERTURE OBSTRUCTIONS AND RADOME FINISHES UPON RADOME ELECTRICAL CHARACTERISTICS

J. R. Rogers *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. V [1964] 28 p (See N65-11852 02-07)

Radar performance is degraded by the installation of hardware in the window area of the radome. Rain erosion coatings and protective finishes also affect radome electrical characteristics. Effects of installations such as pitot static booms, fairings, or pods attached to the radome to house electronic systems, paint, and other protective finishes are discussed. Author

N65-11862# Hughes Aircraft Co., Culver City, Calif. Infrared Systems and Guidance Heads Lab.

MEASUREMENTS OF DYNAMIC COLLIMATION ERROR

D. L. Loyat and J. R. Mauer *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. V [1964] 20 p (See N65-11852 02-07)

The dynamic-collimation-error test facility is used to measure collimation-error derivatives and to evaluate the electrical characteristics of sealed guidance units and individual radomes when combined with different microwave systems. Thus, not only radome errors but also those due to the antenna, to the antenna support structure, and to components aft of the antenna can be evaluated. The parameters to be determined for the collimation-error measurement are defined; the facilities for measuring boresight error and collimation error are described; and the techniques devised for the error determination are discussed. D.S.G.

N65-11863# Budco Engineering Co., Torrance, Calif.
A TECHNIQUE FOR ELECTRICAL EVALUATION OF ELECTROMAGNETIC WINDOW AND RADOME SHAPES Engineering Paper No. 641
Forrest L. Coling *In* Ohio State U. Res. Found. Proc. of The OSU-RTD Symp. on Electromagnetic Windows, 2-4 Jun. 1964, Vol. V [1964] 9 p (See N65-11852 02-07)

Electrical evaluation of radome shapes will provide data that can be used to influence preliminary design approaches, estimates of design time required to study alternate shapes, data for inputs to proposal programs, a method for obtaining data on alternate design approaches for a vehicle, a means for obtaining design and performance data for many design studies, and a means for saving design time by studying many shapes on the computer as opposed to the empirical (test) approach on fabricated prototype parts. Comparing data for one radome shape with another primarily shows a change in the magnitude of the incidence angle discontinuity across the radome. Large incidence angles, common to sharp pointed shapes such as cones, cause high losses in electrical performance. This results in a decrease in transmission and an increase in reflection and discontinuity in the phase front. Author

N65-11869*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON FREQUENCY MEASUREMENTS AND RESOLUTION
Alan M. Demmerle Washington, NASA, Dec. 1964 10 p ref
(NASA-TN-D-2216) OTS Prices: HC $0.50/MF $0.50

This article relates the resolution to which the frequency of a sine wave can be measured (using zero-crossing techniques) to the signal-to-noise ratio of the wave, and the time available to make the wave measurement. It demonstrates the need for making measurements over a constant time interval, instead of a constant number of cycles, if the resolution of measurement is to be independent of frequency. Author

N65-11870*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF DIELECTRIC COVERS OVER SHUNT SLOTS IN A WAVEGUIDE
William F. Croswell and Robert B. Higgins Washington, NASA, Dec. 1964 43 p refs
(NASA-TN-D-2518) OTS Prices: HC $1.25/MF $0.50

The purpose of this study was to determine experimentally the effects of placing a dielectric cover over a shunt slot in a waveguide. Slot lengths and displacements were chosen so that the data cover the waveguide bandwidth for dielectric constants from 1 to 4. Formulas are developed, by utilizing the measured data, for the mean values of slot conductance and resonant frequency where the cover thickness is greater than one-fourth of the wavelength in the dielectric material at resonance. In addition, it is shown that plane wave theory gives a bound on the conductance variation for covers thicker than one-fourth of the wavelength in the dielectric material. Pattern and voltage-standing-wave-ratio (VSWR) measurements of linear arrays of dielectric-covered slots designed from single-slot data are presented, along with predicted patterns and VSWR for comparison. Author

N65-11876# Philco Corp., Blue Bell, Pa. Advanced Technology Lab.
NON-PLANAR ARRAY "THINNING" STUDY First Quarterly Report
Charles E. Clarke and Thomas J. B. Shanley Griffiss AFB, N.Y., RADC, Oct. 1964 72 p refs *Its* Rept.-2594-1
(Contract AF 30(602)-3337)
(RADC-TDR-64-341; AD-608174)

This report describes the work completed on an investigation to establish guidelines for designing thinned, nonuniformly spaced array antennas of spherical or hemispherical configuration. The work accomplished includes the following: (1) evolution of a systematic method for locating the element positions in the filled-in array, based on icosohedral partitioning; (2) comparison of deterministic, random, and constrained random thinning procedures; (3) formulation of analytical techniques for calculating probabilities that main beam and sidelobe levels of randomly thinned spherical arrays will fall within specified limits; and (4) partial completion of computer programs required to generate array patterns for hypothetical thinned spherical arrrays. Author

N65-11967# Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
TRANSVERSE FOCAL REGION OF A SPHERICAL REFLECTOR. PART 2: POLARIZATION Scientific Report No. 1
Geoffrey Hyde and Roy C. Spencer May 1964 42 p refs
(Contract AF 19(628)-2758)
(AFCRL-64-292 II; AD-607477)

The polarization of the reflection of a uniform plane wave incident on a spherical reflector is analyzed using the current distribution method for scattered fields. It is seen that the effective current, the component radiating in the direction of the circle of least confusion, has essentially the same polarization as the specularly reflected fields. Formulas for the current distribution on the reflector and the effective current are derived in several ways. The effective current is graphed, and contour plots are given. Formulas for the fields reflected from the tangent plane are derived in terms of direction cosines. These formulas are discussed, and contour plots of the field components are given. Author

N65-11969# Purdue Research Foundation, Lafayette, Ind.
A DETERMINATION OF THE ELECTROMAGNETIC SCATTERING FROM A CAVITY-BACKED PLANE SURFACE Physical Sciences Research Papers No. 50
John K. Schindler and Floyd V. Schultz Bedford, Mass., AFCRL Sep. 1964 100 p refs
(Contract AF 19(604)-4051)
(AFCRL-64-784; AD-607900)

A determination is made of the electromagnetic scattering from an infinite plane surface backed by an infinitely long rectangular cavity. The cavity is coupled through the plane surface by a narrow, infinitely long aperture running parallel to the axis of the cavity. The structure is excited externally by a plane wave of arbitrary polarization and arbitrary angles of incidence. In the formulation given, a pair of singular integral equations governs the behavior of the tangential components of the electric field in the aperture (the aperture fields). The integral equations are solved using a standard perturbation technique under the assumption of a small aperture width in wavelengths. The fields scattered by the structure consist of the superposition of a field specularly reflected from the plane surface and a field reradiated by the induced aperture fields. The far-scattered field excited by the nonzero aperture fields is calculated by applying the method of steepest descent to the field integrals. Author

N65-11970# Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
ON THE USE OF REFRACTIVE INDEX DIAGRAMS FOR SOURCE-EXCITED ANISOTROPIC REGIONS
L. B. Felsen 10 Sep. 1964 43 p refs
(Contract AF 19(628)-2357)
(PIBMRI-1239-64; AFCRL-64-799; AD-607960)

The use of refractive index diagrams in the study of plane wave propagation in unbounded and layered anisotropic media is reviewed and then extended to account for certain aspects of the radiation from confined source distributions. Such items as the radiation condition, saddle point location, focusing effects, lateral ray trajectories, Cerenkov radiation, and others are interpreted via the refractive index plots. Author

N65-11971# Sylvania Electric Products, Inc., Williamsville, N.Y.

PSEUDO PASSIVE SATELLITE TECHNIQUE STUDY Final Report

Griffiss AFB, N.Y., RADC, Oct. 1964 155 p refs

(Contract AF 30(602)-2957)

(RADC-TDR-64-157; AD-608141)

The pseudopassive satellite technique uses antenna elements with incorporated tunnel-diode amplifiers placed on a surface to increase the scattering cross section of the surface. The study results give stability criteria for the coupled tunnel-diode amplifiers, scattering patterns of arrays of antenna elements and criteria to eliminate lobing in the pattern, and tunnel diode amplifier and element design criteria. Experimental results of tunnel-diode reliability and of parameter variations with temperature are given. An array of X-band integrated antenna elements and tunnel-diode amplifiers was tested. Based on the results of the above investigations, the pseudopassive satellite technique is feasible. Author

N65-12013# Aerospace Corp., El Segundo, Calif. Telecommunications and Tracking Dept.

RELATIVE ACCURACY OF AZUSA AND DOWNRANGE GLOTRAC AT A POINT OF OVERLAPPING COVERAGE

J. L. Wittels 30 Dec. 1963 31 p refs

(Contract AF 04(695)-269)

(TOR-269(4116-22)-2; AD-435049)

In comparing the results of the study of the two systems, it is first noted that the Azusa X and Y axes are not aligned with the Glotrac X' and Y' axes. Therefore, the individual sigmas cannot be compared directly. It is shown that Glotrac position accuracy is significantly less than that of Azusa. However, since the computed accuracies are for the systems working alone, the combination of the two systems should yield redundant data that would result in an overall metric data accuracy significantly greater than that of either system working alone. D.E.W.

N65-12046# Marchetti (J.W.) Inc., Natick, Mass.

100 MEGACYCLE VHF RE-ENTRY RADAR FOR STALLION SITE, WHITE SANDS MISSILE RANGE AN/TPQ-20 Final Report

Griffiss AFB, N.Y., RADC, Aug. 1964 124 p

(Contract AF 30(602)-2824)

(RADC-TDR-64-303; AD-607043)

A 100-Mc, 1-MW, variable-pulse-width (1μsec, 2.5μsec, and 5μsec), radar, the AN/TPQ-20, was installed for the purpose of viewing and photographically recording A-scope displays of the Athena test vehicles. Vertically polarized signals were transmitted, and two receivers were used, one for vertically polarized and one for horizontally polarized signals. The vertical and horizontal signals were recorded photographically on a pulse-to-pulse basis, together with range time. Ancillary data were paper recorded on Brush recorders. The antenna consists of five yagis mounted on an azimuth elevation mount and pointed to the area of interest by slaving the entire mount to an FPS-16 or L/uhf precision radar. Author

N65-12057# Aerospace Corp., El Segundo, Calif. Engineering Div.

APPROXIMATE CALCULATION OF RF ATTENUATION FOR A LIFTING RE-ENTRY VEHICLE

F. A. Vicente 11 Jun. 1963 40 p refs

(Contract AF 04(695)-169)

(TDR-169(3116-40)TN-2; SSD-TDR-63-112; AD-413514)

The effect of ionized air on electromagnetic waves is investigated to compare some crude predictions with some experimental data and to offer a possible solution to the communications blackout problem with reentry vehicles. Investigations are restricted to the normal shock and far-field calculations in order to show that a fairly good approximation can be obtained from a rather simple approach to a flow-field analysis. A drastic reduction in rf signal attenuation is shown to be possible by reducing the wedge angle and increasing the sharpness of the nose. Author

N65-12058# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.

ELECTRONICS PROGRAM: RADIO FREQUENCY INTERFERENCE AT ORBITAL ALTITUDES Semiannual Technical Note, 1 Jan.–30 Jun. 1963

L. A. Hoffman, K. H. Hurlbut, and C. J. Zamites 7 Oct. 1963 15 p refs

(Contract AF 04(695)-169)

(TDR-169(3250-44)TN-1; SSD-TDR-63-260; AD-421754)

The broad objectives of this program are to study the rfi problem and to investigate the design of monitoring instruments suitable for making in-space measurements of the electromagnetic environment. Toward this objective laboratory development of a compact, lightweight receiving system in the 200 to 1000 Mc band has been initiated. The receiving system is to consist of an antenna array, a bank of interdigital bandpass filters, and 16 crystal-video receivers. The results of tests on breadboard and prototype circuits have demonstrated the feasibility of this instrumentation concept. Author

N65-12063# Lincoln Lab., Mass. Inst. of Tech., Lexington

HAYSTACK POINTING SYSTEM: MOON Group Report No. 1964-45

H. E. Frachtman 10 Sep. 1964 36 p refs

(Contract AF 19(628)-500)

(ESD-TDR-64-371; AD-606154)

Moontrack is a program in the Haystack Univac 490 pointing system whose output is the celestial coordinates of the moon at a given time. The program computes the coordinates by 4th difference interpolation in the tables of the apparent right ascension, declination, and radius vector of the moon. The rates of change of the three quantities are computed by numerical differentiation. Author

N65-12073# White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group

HANDBOOK OF TIMING TECHNIQUES

Jul. 1964 184 p

(IRIG-103-63; IRIG-105-63; AD-448478)

The need for precise time synchronization on a global basis was investigated. Valid requirements exist for one-microsecond synchronization at some user instrumentation, while 10-microsecond synchronization may be adequate in other applications. Methods of achieving required synchronization accuracies were evaluated. The problem involves two major areas: (1) accurate synchronization of the master generators, and (2) distribution to the user sites without degradation beyond the required limits. Methods for processing the standard timing

formats to operate equipment at instrumentation sites are included. Author

N65-12069# Navy Underwater Sound Lab., New London, Conn.
PATTERN FACTORS OF OPEN-CIRCUITED HORIZONTAL ELECTRIC MONOPOLE ANTENNAS LOCATED ON OR VERY NEAR A FINITELY CONDUCTING MEDIUM
Peter R. Bannister and Jane E. Christensen 10 Mar. 1964 92 p
(USL-TM-941.1-14-64; AD-604013)

The efficiency of horizontal electric dipole or monopole antennas follows a series of maxima and minima when plotted as a function of length. The first maximum, which is the first order resonance, is of the greatest importance, since it corresponds to the maximum attainable efficiency for the figure-eight-type surface-wave pattern of the antenna. Although greater maximum efficiencies are sometimes possible with longer antennas of higher order resonances, the patterns become multilobed, and the overall antenna efficiency is greatly reduced. It is the purpose of this technical memorandum to clarify the preceding statement by examining the pattern factors of antennas of various electrical lengths, realizing that there are advantages to be gained in certain situations by employing antennas characterized by multilobed patterns. Of the two types of horizontal electric monopole antennas, only the open-circuited (conductor completely insulated from the conducting medium) is considered. Author

N65-12149# Illinois U., Urbana Engineering Experiment Station
PLANE WAVE DIFFRACTION BY THICK DIELECTRIC GRATINGS, AND ZONE PHASE PLATES
H. A. Shubert Jun. 1964 139 p refs
(Contract AF 33(657)-10474)
(TR-77; AD-603026)

The diffraction of a plane electromagnetic wave by an infinite grating of dielectric bars is obtained by two methods. One is an improved wave optics method, accounting for multiple reflections. The other is a more exact formulation as a boundary-value problem, which is solved numerically. The results are compared with each other and with experiment. The diffraction is specified in terms of the amplitudes of the grating lobes, both the "real" classical lobes and the lobes with complex "directions," corresponding to waves evanescent in the direction normal to the grating. The latter are found to be relatively negligible, as compared to those for a grating of perfect conducting bars, for example. This important result is discussed at length. Author

N65-12193# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
DETERMINATION OF TRACE AMOUNTS OF MOLYBDENUM AND NIOBIUM IN TUNGSTEN USING A SMALL ANION EXCHANGE COLUMN Technical Documentary Report, Jan. 1963–Jun. 1964
Ken F. Sugawara Sep. 1964 16 p refs
(ML-TDR-64-268; AD-608074)

Tungsten, the matrix material, passes through the column while the impurities, molybdenum and niobium, are adsorbed by the anion exchange resin. Molybdenum and niobium are then selectively eluted from the resin column and determined spectrophotometrically. Author

N65-12202*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE RESOLUTION OF FREQUENCY MEASUREMENTS IN PFM TELEMETRY
Alan M. Demmerle and Paul Heffner Washington, NASA, Dec. 1964 18 p refs
(NASA-TN-D-2217) OTS Prices: HC $0.50/MF $0.50

This article outlines a method for high-resolution measurements of pulse-frequency-modulation telemetry signals mixed with additive gaussian noise. The relations between the resolution and the signal-to-noise ratio, and between the resolution and the satellite range are given. Author

N65-12206*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
TELEMETRY DESIGN
Walt C. Long *In its* Micrometeoroid Satellite Explorer XIII (1961 Chi) Nov. 1964 p 35–78 refs (See N65-12203 02-31) OTS Prices: HC $3.50/MF $1.25

The telemetry system for Explorer XIII consisted of two separate and independent telemeters for data transmission and a radio beacon for tracking. The two telemeters were of the data storage–command readout type wherein data were collected during the satellite's orbits and read out when within range of a ground receiving station. Data storage was sufficient to allow up to 24 hours to elapse between readouts. Two radio frequencies were used for data transmission, but only one command radio frequency was used for interrogation. Due to the initial spinning and the eventual tumbling modes of the satellite, an isotropic antenna system was a necessity. An additional requirement was that the antennas be stowable during the launch phase and automatically unfold when the heat shields were jettisoned. The selected antenna system consisted of four erectile monopoles spaced 90° electrically and 90° physically around the satellite body in a turnstile array. Also covered are channel allocations, ground compatibility tests, and operational results. R.L.K.

N65-12233# Illinois U., Urbana Electrical Engineering Research Lab.
THEORETICAL PATTERNS AND MODEL DATA OF A WARLA DESIGN Technical Report No. 5
John W. Greiser Aug. 1964 43 p refs
(Contract NObsr-89229)
(RRL-255; AD-605534)

Radiation patterns measured on a 500:1 scale model are compared to patterns calculated on a digital computer. The degree of correlation found over the lowest band of the three-band system is then a measure of prediction validity of the program over the other frequency ranges. Reasonably good correspondence is found. A total of 144 log-periodic elements of varying sizes are spaced at 2 1/2° increments around a 1210-ft-diameter circle. Over the range 2 to 32 Mc, it is expected that the first sidelobe will never exceed −10 dB, whereas the azimuthal beamwidth will decrease from 34° to 1 1/2°. A high front-to-back ratio is maintained at all frequencies. Author

N65-12234# Centro di Studio per la Fisica delle Microonde, Florence (Italy)
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF CYLINDRICAL OR TOROIDAL DIFFRACTION REFLECTORS, HAVING A WIDE APERTURE AND FIELD ANGLE, OPERATING WITH DIFFERENT FREQUENCIES AT DIFFERENT FIELD ANGLES Final Technical Report, 1 Jun. 1963–31 May 1964
V. Russo and G. Toraldo di Francia [1964] 45 p refs
(Contract DA-91-591-EUC-2953)
(AD-447933)

Summarized are experimental and theoretical examinations of a cylindrical diffraction reflector with circular cross section, and having the following properties: (1) It is perfectly corrected

for all geometrical aberrations, for a point source at infinity in a given direction (axis), and for a given wavelength. (2) The focus is chosen so as to satisfy the sine condition. (3) The steps constituting the real surface are oriented so as to satisfy the blaze condition all over the pupil for the design wavelength. The performance of the antenna was investigated at oblique incidences and at frequencies other than the design frequency. P.V.E.

N65-12265# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J. Switching and Multiplexing Div.
CONVERSION AND RECONVERSION OF FREQUENCY-DIVISION MULTIPLEXED SIGNALS TO PULSE-CODED SIGNALS
M. Pickover Aug. 1964 15 p refs
(TR-2488; AD-607797)

The conversion of a frequency-division multiplexed (FDM) signal to a pulse-code modulation (PCM) signal and the reconversion to its original FDM signal have been accomplished. Some of the theoretical considerations and actual results are discussed and tabulated. An application of a complete system and its advantages are presented. Author

N65-12304*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A TECHNIQUE FOR VISUAL DETECTION OF DISTANT OBJECTS IN SPACE BY USE OF OPTICAL FILTERING
Kenneth R. Garren Washington, NASA, Dec. 1964 20 p refs
(NASA-TN-D-2531) OTS Prices: HC $0.50/MF $0.50

A new technique is described for visually detecting and identifying distant objects in space by using only sunlight reflected from the target and optical filtering. Visual target enhancement is achieved (without the aid of onboard artificial illumination) by a set of optical filters, which cause the target to blink against a nonblinking background. Several optimizing conditions for visual target detection using this technique are discussed. Results of experimental studies indicate that such a filter technique would allow detection in the sunlit regions at target luminance levels of the order of fourth and fifth magnitude, where beacon power requirements for equivalent illumination are large, and would permit detection independent of target angular motions. Author

N65-12317*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE VEHICLE SA-4, TELEMETRY SYSTEM
E. H. Reeves, Jr., J. R. Stovall, and W. B. Threlkeld, Jr. 26 Oct. 1964 123 p
(NASA-TM-X-53153) OTS Prices: HC $4.00/MF $1.00

The performance evaluation of the complete telemetry system (ten links) used for flight testing Saturn vehicle SA-4 is presented. The eight operable telemetry links, the two experimental telemetry links, and the telemetry (TM) auxiliary equipment assembly have been technically analyzed on an individual basis. Statistical analyses were performed on much of the telemetry data, and results of these analyses are presented. No rf signal fade or dropout difficulties were encountered on any of the links. A malfunction of the PCM system occurred during the flight. An analysis of the cause and effect of this malfunction is included. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-10981# New York U., N.Y. AEC Computing and Applied Mathematics Center
MONTE CARLO STUDIES OF SYSTEMS OF HARD SPHERES
Aubey Rotenberg 1 Oct. 1964 71 p refs
(Contract AT(30-1)-1480)
(NYO-1480-3)

Monte Carlo studies have been carried out for systems of hard spheres in one (hard rods), two (disks), and three dimensions. The experiments are described in some detail along with the results. The existence of a phase transition in both two and three dimensions has been confirmed. In an attempt to study the transition further, the effect of imposing a gravitational field on the system was investigated, and it was found that the field does not separate out the two phases. A possible model for what happens at the phase transition is suggested and discussed. Author

N65-10987# Joint Publications Research Service, Washington, D.C.
CERTAIN PROBLEMS OF CYBERNETICS
V. Glushkov, A. Dorodnitsyn, and N. Fedorenko 19 Nov. 1964 9 p Transl. into ENGLISH from Izv. (Moscow), 6 Sep. 1964 p 4
(JPRS-27440; TT-64-51689) OTS: $1.00

Presented is a general discussion of the application of computer technology to the fields of calculation, control, and planning of a national economy. P.V.E.

N65-11080# Systems Research Labs., Inc., Dayton, Ohio
A NEW APPROACH TO COMPUTER COMMAND STRUCTURES Final Technical Report, 15 Sep. 1963–15 Mar. 1964
C. K. Kim, L. E. Irwin, and E. B. Maier Griffiss AFB, N.Y., RADC, May 1964 90 p refs
(Contract AF 30(602)-2741)
(RADC-TDR-63-135; AD-607363)

The purpose of the research was to investigate programing manipulation and associated problems using the algebraic computer language (theta-language). The report contains a refinement of the theta-language, the description of the meta-language as a source language, the definition of the theta-language in terms of metalanguage, the establishment of the theta-language as a precedence language, and the syntactic structure of the theta-language. It also contains the programing manipulation of the theta-language, the theoretical investigation of the prime phrase structure of the theta-language, and application of linear graph theory to programing control. Author

N65-11086# State U. of Iowa, Iowa City
DATA ACQUISITION AND REDUCTION. PHASE VI, PART I: BALLOTING PHENOMENA IN ROCKET-LAUNCHER FIRINGS

James E. Crosheck 22 Jul. 1964 43 p refs
(Contract DA-11-070-508-ORD-1232)
(Rept.-11; AD-608262)

This report presents the results of a study of the balloting behavior of a rocket on a straight rail launcher. Numerical computations have been made for two angles of elevation and are presented in graphical form. Author

N65-11087# State U. of Iowa, Iowa City
DATA ACQUISITION AND REDUCTION. PHASE VII: PREDICTION OF RESULTS OF AN EVENT FROM SAMPLE DATA ANALYSIS
Royce Beckett and James Hurt 7 Aug. 1964 51 p refs
(Contract DA-11-070-508-ORD-1232)
(Rept.-12; AD-607092)

This report investigates various methods for reducing experimental records from a sample of similar events. The objective of the investigation is to find a method for predicting the outcome or result of this event in future trials. Statistical methods are used to find whether the probability that results from the event will fall within a given range of values. The various procedures that are studied are illustrated with a sample of seven data traces. Author

N65-11089# David Taylor Model Basin, Washington, D.C. Hydromechanics Lab.
A MULTICHANNEL DIGITAL DATA ACQUISITION SYSTEM
James A. Luistro Sep. 1964 56 p refs
(DTMB-1630; AD-607687)

A digital data acquisition system (DIDAS) is discussed with emphasis on its concepts and capabilities. Any arbitrary combination of 43 inputs made up of 36 analog inputs, 6 digital inputs, and 1 event pulse input may be sampled at rates up to 6000 samples per second, digitized where necessary, and recorded on magnetic tape. These output digital tapes are suitable for direct entry into an IBM-7090 or similar digital computer. Since the primary function of DIDAS is to sample, digitize, and record analog data, the system is considered a 36-channel system, and it is with this principal consideration that the operational and performance characteristics are described. Author

N65-11124# Hanford Atomic Products Operation, Richland, Wash. Chemical Labs.
ISOGEN—A COMPUTER CODE FOR RADIOISOTOPE GENERATION CALCULATIONS
H. H. Van Tuyl Sep. 1964 35 p refs
(Contract AT(45-1)-1350)
(HW-83785) OTS: $2.00

ISOGEN (isotope generation) is a computer program for calculating radioisotope generation and decay with chains containing up to 50 members each. Accuracy is ordinarily within 0.1% for each time step. Any number of the nuclides may have similar or even identical decay constants without affecting accuracy. Branching may occur by radioactive decay, neutron capture, or fission at any chain member. Much of the input is basic nuclear data in normal units (symbol, half-life, radioactive branching ratio, energy per decay, cross sections, fission yields, and daughter products). Output is expressed in atoms, grams, curies, beta watts, and gamma watts. Time in normal units, flux in neutrons/cm^2-sec, and ratio of resonance to thermal neutrons is specified for up to 30 steps. An option is available to use power level as input data instead of flux. The flux required to obtain the desired average power level over the irradiation time step is calculated. Author

N65-11159# Boeing Co., Seattle, Wash.
NON-SIMILAR BOUNDARY LAYER—REAL GAS COMPUTER PROGRAM, DECK AS 1188
C. Jaeck and W. Jackson [1964] 379 p refs
(Contract AF 33(615)-1791)
(D2-81296; AD-446581)

This program provides detailed calculations of laminar boundary-layer characteristics for either stagnation or nonstagnation flow, including three-dimensional effects and mass injection. A brief description of the numerical method is given, followed by a detailed description of the equations and calculations. Numerical instability of the boundary-layer equations is discussed, and stability relationships are presented. A sample case is included to illustrate input–output display. Flow charts and program listings are also given. The program is written in the FORTRAN II and FAP languages for the IBM 7094 digital computer. Author

N65-11192# Ohio State U. Research Foundation, Columbus Antenna Lab.
A COMPUTER PROGRAM FOR RADAR CROSS SECTIONS OF DIELECTRIC BODIES USING THE MODIFIED GEOMETRICAL OPTICS METHOD Scientific Report No. 28
Li-Jen Du 15 Jan. 1964 45 p refs *Its* Rept.-1116-42
(Contract AF 19(604)-7270)
(AFCRL-64-715; AD-606093)

A computer program has been written using the modified geometrical optics method for evaluating the electromagnetic scattering from a cylinder made of plasma or dielectric material. It can be applied in general to two-dimensional dielectric bodies of arbitrary shape and permittivity after minor modifications. A description and details of the program are included. Author

N65-11292# Michigan U., Ann Arbor Inst. of Science and Technology
RESEARCH AND DEVELOPMENT OF AN SFM DATA CORRELATOR Final Report, Jul. 1963–May 1964
D. R. Brundage, E. K. Holland-Moritz, and J. C. Duté Wright-Patterson AFB, Ohio, AF Avionics Lab., Aug. 1964 65 p refs *Its* Rept.-5751-11-F
(Contract AF 33(657)-11465)
(AL-TDR-64-161; AD-604427)

A feasibility model of an SFM data correlator has been constructed that performs the discrete equivalent of the correlation integration required at the receiving terminal of a PCM/SFM communication system. Techniques that lend themselves to miniaturization were used in designing the model so that the correlator would be practicable in an aerospace environment. The correlator is all-electronic and uses a hybrid computer with a digital shift register and analog multipliers. Data rates from dc to 200000 bits/sec are possible. Construction details are given, and a brief discussion of signal design is included. Author

N65-11412# Research Analysis Corp., McLean, Va. Advanced Research Div.
THE SEQUENTIAL UNCONSTRAINED MINIMIZATION TECHNIQUE FOR NONLINEAR PROGRAMMING. ALGORITHM II: OPTIMUM GRADIENTS BY FIBONACCI SEARCH
Anthony V. Fiacco and Garth P. Mc Cormick Jun. 1964 26 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-123; AD-450546)

The technique is an adaptation of a Fibonacci-search procedure that replaces the simple bracketing procedure

previously used and results in a reduction in total problem solution time of almost one half. A new normalized final-convergence criterion that does not depend on the magnitude of the optimum solution value is given. The detailed computer solution of a chance-constrained linear programing problem illustrates the typical convergence characteristics of the method. A concise and simplified review of all the method's important computational aspects is given for completeness.
Author

N65-11419# Army Missile Command, Huntsville, Ala. Electromagnetics Lab.
SIMPLIFIED SYNTHESIS TECHNIQUES FOR COMPENSATION OF SAMPLED DATA CONTROL SYSTEMS
Gilbert C. Willems 30 Sep. 1964 35 p refs
(RE-TR-64-20; AD-450201)

This report presents tables that simplify the procedure of compensating sampled data control systems with pulsed RC networks. Military applications relating to command and homing guidance are outlined, and numerical design examples are presented.
Author

N65-11778# Naval Research Lab., Washington, D.C. Sound Div.
DATA HANDLING SYSTEM FOR THE BENDIX G-15D DIGITAL COMPUTER
G. V. Olds, C. Mc Coy, Jr., and H. L. Peterson 23 Sep. 1964 21 p refs
(NRL-6144; AD-607398)

This report describes methods and equipment used for transferring experimental data into a digital computer. The data are obtained at remote field stations by sampling, encoding, and storing in digital form on magnetic tape, signals obtained during experiments concerning underwater sound. The computer is used for correlation studies and other statistical analyses. The system described includes provision for the reading of continuous field tapes into the computer, selection of data by means of visual display, and an x-y plot of results. Details of hardware and programs using the computer as central processor are discussed.
Author

N65-11794# Aerospace Medical Div. Aeromedical Research Labs., 1657Oth/, Wright-Patterson AFB, Ohio
ERROR CONTROL METHODS FOR AN AUTOMATIC CHECKOUT SYSTEM Final Report, 1 Jan.–14 Dec. 1963
Walter J. Huebner and Theodore S. Lewis (IIT Res. Inst.) Mar. 1964 155 p refs
(Contract AF 33(657)-10271)
(AMRL-TDR-64-17; AD-607735)

One of the two objectives was the development of error control techniques for the man–computer interface of an automatic checkout system. To minimize human error in man–computer communication in the automatic checkout complex, precedence and connection matrix techniques for use with total and partial simulation methods were developed to detect errors in operational automatic checkout computer programs. Precedence and connection matrix techniques for use with total simulation methods were incorporated into a simulation computer program that comprised a total simulation of the computer that controls an operational automatic checkout system. The modified simulation was then used to process several computer runs of an operational automatic checkout computer program. The basic conclusions drawn from the results of the study of error control methods were that precedence and connection matrix techniques used with total and partial simulation methods can be useful in detecting errors in operational computer-controlled automatic checkout systems; and that further study and development should be made to allow incorporation of the techniques in present and future computer-controlled automatic checkout systems with minimum modification.
Author

N65-11927# Rome Air Development Center, Griffiss AFB, N.Y. Research and Technology Div.
FLOPAK: FLOATING POINT PROGRAMING PACKAGE
Steve Cordell Oct. 1964 56 p
(RADC-TDR-64-395; AD-607885)

The FLOPAK is a Packard-Bell 250 Computer semi-automatic, floating-point programing system that may be operated simultaneously in either of two modes. The first is a nontime optimized mode that may be used by inexperienced coders; the second mode is a high-speed, fully time-optimized floating-point arithmetic system that an experienced programer may use in real-time computations and in general, single precision calculations. It is the only PB-250 floating-point system available that may be used in real-time control.
Author

N65-11932# Joint Publications Research Service, Washington, D.C.
DIGITAL COMPUTERS AND THEIR UNITS
A. N. Myamlin, V. M. Mikhelev, Ye. P. Kuzin, V. Yu. Vershubskiy, and E. I. Naumov 17 Nov. 1964 44 p refs Transl. into ENGLISH of 4 articles from the book "Voprosy Vychislitel'noy Matematiki i Vychislitel'noy Tekhniki" Moscow, 1963 p 124–156
(JPRS-27418; TT-64-51868g) OTS: $2.00

Four papers are presented that concern the following subjects: (1) the general-purpose electronic computer with checking and combining of operations; (2) the arithmetic unit of the general-purpose electronic digital computer with checking and combining of operations; (3) the potential accumulator with a summation time of 0.5 microseconds; and (4) the high-density storage of numerical information on a magnetic drum. The papers describe various parts and the whole of a computer with an operating cycle of 8 microseconds, with four types of memory units synchronized for information exchange with the arithmetic unit, with germanium-diode logic circuits and radio-tube amplifiers, and with a basic operating frequency of 1 Mc/sec.
D.E.W.

N65-11962# Melpar, Inc., Falls Church, Va.
FEASIBILITY STUDIES ON USE OF ARTRONS AS LOGIC ELEMENTS IN FLIGHT CONTROL SYSTEMS Final Report
K. E. Mirabelli, E. M. Connelly, and J. E. Worthen Wright-Patterson AFB, Ohio, Flight Dyn. Lab., Sep. 1964 144 p
(Contract AF 33(657)-11028)
(FDL-TDR-64-23; AD-607764)

Results of the theoretical studies of the use of redundant self-organizing elements as a means of providing a reliable self-organizing controller are presented. A mathematical representation of the trainable logical network as a finite state device and an analysis of the organization process as a Markov process are given. Goal functions for control systems are developed from Lyapunov functions. A digital computer study of the self-organizing logical controller and study results are presented. The theory, method of operation, and design techniques of the RELIATRON (Reliable ARTRON) are given.
Author

N65-11979# Joint Publications Research Service, Washington, D.C.
THE THEORY OF AUTOMATIC MACHINES AND ITS APPLICATIONS

V. M. Glushkov 2 Dec. 1964 11 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 7, Jul. 1964 p 25–30
(JPRS-27634; TT-64-51838) OTS: $1.00

A definition is given of an abstract automatic computing machine. The theory of machines of this type is discussed in terms of a problem of translation of a phrase from one language to another. D.E.W.

N65-11991# United Nuclear Corp., White Plains, N.Y. Development Div.
UNC-SAM: A FORTRAN MONTE CARLO SYSTEM FOR THE EVALUATION OF NEUTRON OR GAMMA-RAY TRANSPORT IN THREE-DIMENSIONAL GEOMETRY
B. Eisenman and F. R. Nakache 31 Aug. 1964 146 p refs
(Contract DA-30-069-ORD-3625)
(UNC-5093; AD-605458)

The code system calculates fluxes, flux-dependent functionals such as doses, and their standard deviations in geometry (rectangular parallelepipeds which, in turn, may contain spheres, cylinders, parallelepipeds, or wedges). In order to increase the efficiency of the Monte Carlo transport game, UNC-SAM uses an importance sampling technique. In addition, in the particular case of evaluating neutron fluxes in small volume detectors, a scoring by analytical estimation referred to as "flux at a point" is employed. Author

N65-12043# Harry Diamond Labs., Washington, D.C.
ANALOG COMPUTER TECHNIQUES FOR PROBLEMS IN COMPLEX VARIABLES
Arthur Hausner 30 Sep. 1964 54 p refs
(TR-1250; AD-451097)

By programing pairs of amplifiers to represent the real and imaginary parts of complex variables on an analog computer, techniques are developed that permit the mechanization of the method of steepest descents, for finding roots of complex functions, in Cartesian coordinates; simplify the generation of square-root and division circuits; allow the generation of complex functions utilizing the Cauchy integral theorem; and enable a programer to scan the z-plane efficiently when electronic mode control and track-and-hold circuitry are available. Author

N65-12061# System Development Corp., Santa Monica, Calif.
THE FUNCTIONAL TIME DIAGRAM METHOD OF COMMAND AND CONTROL SYSTEM ANALYSIS
Marc Bendick 28 Aug. 1963 16 p
(SP-1111; AD-422673) OTS: $1.60

Functional time diagram (FTD) methodology, including vocabulary and techniques, is described. At present, the definitions and procedures are fluid and may be varied to fit particularly unique systems. Two fundamental assumptions are made: (1) The system kinetics are essentially those of an open-loop system, because the time delay of the feedback is usually so great that the second cycle of a decision is made in a different environment from that of the first. (2) The system must satisfy the criterion of being able to perform successfully the function with the means at hand and within the environmental time available. Thus, the FTD method tests functional integrity within a real-time constraint. The diagram is constructed with time on its horizontal axis and with operations arranged on a nondimensional vertical axis; the size of the symbol is independent of the time values, and information flow lines indicate the time of starting or stopping the operations. The described procedures are for manual analysis, but most of the procedures are suitable for machine analysis. M.P.G.

N65-12172# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COMBINATION COMPUTERS Selected Articles
9 Oct. 1964 32 p refs Transl. into ENGLISH from Trudy, Vsesoyvzn. Konf.-Seminar po Teor. i Metodam Mat. Modelirovaniya (Moscow), 1962 p 80–91, 106–113
(FTD-MT-64-218; AD-607877)

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1. ON METHODS OF INCREASING THE HIGH SPEED OPERATION AND EXPANDING THE LOGICAL POSSIBILITIES OF DIGITAL DIFFERENTIAL ANALYZERS (DDA) A. V. Kalyayev p 1–16
2. INTEGRATION BLOCK OF A DIGITAL INTEGRATING MACHINE B. V. Barun, E. M. Zelinskiy, and V. I. Sergiyenko p 17–28

N65-12210*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DATA REDUCTION
Sheldon Kopelson *In its* Micrometeoroid Satellite Explorer XIII (1961 chi) Nov. 1964 p 145–156 (See N65-12203 02-31) OTS Prices: HC $3.50/MF $1.25

The telemeter signal is a nonsynchronous time-division multiplex, containing information coded in three independent forms: duration of subcarrier oscillation bursts, frequency of the oscillations, and the time (spacing) between the bursts. The data readout system decommutates and digitizes this information, and records the digitized data on magnetic tape in computer format. The readout of data coded in all three forms is simultaneous and is done at a rate of up to 25 channels per second. A major design criterion of the data readout system was that the performance should be satisfactory when there was a significant amount of noise in the telemeter signal. Author

N65-12229# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STARS SIX-DEGREE-OF-FREEDOM ANALOG SIMULATION PROGRAM
V. E. Jones, Jr. et al 31 Jul. 1964 53 p refs
(LMSC-6-62-64-11)

This report presents a description of the six-degree-of-freedom analog computer program, which is used with the STARS Control Display Simulator. The vehicle configuration assumed for initial studies is that of a modified Gemini. A general discussion of the program capability is given, along with the mathematical model, mechanization diagrams, and equipment list. Author

N65-12258# Pratt and Whitney Aircraft, Middletown, Conn.
TDP—A TWO-DIMENSIONAL PERTURBATION CALCULATION CODE BASED ON TDC, FOR IBM-7090, DECK B 51
W. J. Fader 20 Nov. 1964 37 p
(Contract AT(30-1)-2789)
(PWAC-446) OTS: $1.00

The TDP is a linear perturbation-theory code programed for the FLOCO system for the IBM 7090. The code may be used to calculate changes in k_{eff} for perturbations of the material cross sections in a single region of a reactor configuration calculated by the TDC code. The calculation of neutron prompt lifetime and of effective delayed fraction are TDP options. The forward (regular) and adjoint total fluxes required by TDP are obtained from TDC calculations as binary punched card output. The required forward and adjoint angular fluxes are supplied on tapes written during the TDC calculations. Author

N65-12267# System Development Corp., Santa Monica, Calif.
SYSTEM SIMULATION: A CONCEPTUAL APPROACH
R. I. Ribler 17 Aug. 1964 17 p
(SP-1673; AD-606176) OTS: $1.00

The development of a system simulation within a computer, consisting of real time, nonreal time, digital, digital–analog, and algorithmic or gaming simulation, is discussed. Simulated and/or real inputs can be prepared by the use of the system to be operated upon the real system, including both hardware and software. G.G.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-10985# General Electric Co., Syracuse, N.Y. Electronics Lab.
MICROELECTRONIC MODULES FOR DIGITAL APPLICATIONS Final Report, 1 Jun. 1962–30 Jun. 1963
Louis J. Ragonese Johnsville, Pa., Naval Air Develop. Center, 9 Oct. 1963 46 p ref
(Contract N62269-1685)
(NADC-EL-6358; AD-423687)

A compatible family of three thin-film microelectric digital building blocks were designed and fabricated. The building blocks can be used to perform four levels of logic per clock period synchronized by a two-phase sinusoidal clock whose frequency can be set arbitrarily from zero to 10 Mc in the temperature range −65° to +110° C. Author

N65-10992# Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
DESIGN AND DEVELOPMENT INVESTIGATIONS OF A LOW NOISE, LINEAR, VARIABLE GAIN, R.F. AMPLIFIER TUBE Quarterly Progress Report, 1 Apr.–30 Jun. 1964
J. P. Pietrzyk, A. van der Jagt, and R. L. Pear 30 Jul. 1964 59 p ref
(Contract NObsr-89530)
(QPR-4; AD-604588)

In order to improve the noise level of the tubes without destroying the good level of interference suppression, several changes were made. Sealex and exhausting schedule and construction-detail changes are detailed, and attempts to find a simple, incorporable, automatic-gain control system are outlined. Experimentation showed that the internal tube resistance, although low, could not be raised beyond 32 kΩ without sacrificing some of the good features of the tube construction. Capacitance and inductance measurements, a grid and cathode lead inductance analysis, and noise measurements at 200 Mc/sec and 400 Mc/sec are reported. Tests of the unmodified R390A receiver and of the receiver after modification are discussed. D.E.W.

N65-11000# Western Electric Co., Inc., Laureldale, Pa.
PRODUCTION ENGINEERING MEASURES: HIGH FREQUENCY TRANSISTOR Final Report, 20 Jun. 1961–20 Jun. 1964
T. G. Stoudt [1964] 420 p
(Contract DA-36-039-SC-85969)
(AD-604492)

A review is presented of a project to establish the capability to manufacture the 1000-Mcps GF-40036 germanium transistor on a pilot line basis, to produce engineering test samples, and to initiate a pilot run. All shop operations are described in detail, and standard items, available prior to this contract, are specified in the manufacturing drawings. All drawings, manufacturing layouts, equipment lists, and final test specifications are included. Photographs showing the machinery usually engaged in transistor manufacture and showing several items specifically provided for the microwave device are included. Early engineering development led to a common-base device that, it was believed, would supply the highest power gain with best stability over a broadband. A common emitter transistor (GF-40037) was also developed, and it proved easier to work with in circuit design, especially in broadband applications. Therefore, a pilot run of common emitter units was performed, and a description of manufacturing differences from the GF-40036 is included. D.E.W.

N65-11028# Microwave Associates, Inc., Burlington, Mass.
SOLID-STATE RF GENERATOR Quarterly Progress Report, 31 May–31 Aug. 1963
F. P. Collins [1963] 10 p
(Contract NObsr-89356)
(QPR-1; AD-423933)

Further investigation of high-power and low-power oscillators revealed certain practical limitations, including the following. All oscillators require a high-Q resonant circuit to control the frequency, and this implies a high voltage. High-power oscillators also require high-voltage operation, which, in turn, implies high rf voltages across the variable reactance diode used for tuning purposes. Possible circuits for a low-power oscillator are discussed. D.E.W.

N65-11050# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
RESEARCH ON UTILIZATION OF NEW TECHNIQUES AND DEVICES IN INTEGRATED CIRCUITS Interim Technical Engineering Report, 1 Jun.–31 Aug. 1963
J. A. Narud, N. J. Miller, J. J. Robertson, M. J. Callahan, and J. Soloman Wright-Patterson AFB, Ohio, Electron. Technol. Lab. [1963] 53 p refs
(Contract AF 33(657)-11664)
(AD-422553)

Two design schemes are being investigated for a 20-Mc shift register. Development progress on an optimum active element and a minimum volume, maximum Q inductor for the 60-Mc IF strip is also reported. Author

N65-11073*# Martin Co., Baltimore, Md. Electronic Systems and Products Div.
STUDY OF PROTON RADIATION EFFECTS ON SOLAR VEHICLE ELECTRONIC SYSTEM
Donald C. Latham, Richard J. Allen, and Frank Phalen Sep. 1963 37 p refs
(NASA-CR-59524; ER-13148) OTS Prices: HC $2.00/MF $0.50

The radiation effects on the electronic equipment of a solar spacecraft, designed to withstand the effects of solar radiation for 1 year on a mission carrying it to within 0.3 AU of the sun, are considered. The shielding requirements and the component selection criteria based on the estimated environment for the mission are presented. G.G.

N65-11097# Naval Academy, Annapolis, Md. Science Labs.
SOME ELECTRON RADIATION EFFECTS ON TRANSISTORS: A DATA RE-PRESENTATION TECHNIQUE

Leon Preston Brooks, Jr. (M.S. Thesis) 5 May 1964 125 p refs
(S-5; AD-607863)

The effects of a monoenergetic, constant-dose-rate electron beam on four transistor types are discussed. Measurements were taken in the grounded emitter configuration, both under ambient conditions and while each specific device was under irradiation. The resulting data are presented in a three-step reduction–re-presentation technique that utilizes the variation of gain degradation with ambient forward current gain of the device ($BETA_0$) in a nuclear environment. The three steps are the graphical or first approximation, the computer analysis, and the third step check (the use of pre-irradiated devices in breadboarded circuits). Author

N65-11110# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INSTALLATION FOR EVALUATION OF STANDARD COAXIAL LOADS
A. I. Yel'kind and V. A. Tikhomandritskaya *In its* Invest. in the Area of Radiotech. Meas. 31 Aug. 1964 p 91–101 refs (See N65-11101 02-14)

The installation has been developed to evaluate standard coaxial loads on full conductance (resistance) in the range of 500 to 3,750 megacycles. The main element of the installation is the slitless measuring line that represents the short-circuited section of a coaxial of variable length, to which is joined the evaluated load. A detailed analysis of the errors of such an evaluation is presented, which indicates that the errors are on the order of 3%. M.P.G.

N65-11111# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
METHOD OF MEASUREMENT OF LOSSES IN PRECISION COORDINATING TRANSFORMERS
G. G. Petrosyan *In its* Invest. in the Area of Radiotech. Meas. 31 Aug. 1964 p 102–113 refs (See N65-11101 02-14)

A series of precision coordinating transformers, having high resolving power and minimum losses, were developed for the centimeter range of waves. A method is presented for the measurement of losses introduced by a transformer into the coordinated channel. Author

N65-11121# California U., Livermore Lawrence Radiation Lab.
EXPERIMENTAL TECHNIQUES USED IN UNDERGROUND EQUATION OF STATE MEASUREMENTS
W. H. Gust and B. L. Hord 15 Jul. 1964 26 p
(Contract W-7405-ENG-48)
(UCRL-7931) OTS: $2.00

Critical analysis of the geometric and operational characteristics of a system used for making underground contained equation-of-state measurements is presented. Equation-of-state parameters for a well-known material were measured within uncertainties of less than 1%. Adequate shock-pin reports were recorded for about 99% of the pins used. Author

N65-11135# Radio Corp. of America, Harrison, N.J. Commercial Receiving Tube and Semiconductor Div.
A LOW-DRAIN NUVISTOR OSCILLATOR-AMPLIFIER TRIODE Final Progress Report, 1 May 1962–30 Apr. 1964
N. L. Lindburg [1964] 134 p refs
(Contract DA-36-039-SC-89079)
(Rept.-8; AD-448087)

A low-noise, uhf-amplifier nuvistor triode with low cross-modulation distortions was developed and modified by the addition of two extra cathode leads to improve the uhf performance. This triode is also well suited for operation as a low-level uhf oscillator that is readily tunable over a wide range of frequencies. Life tests up to 5000 hr showed very stable results; and mechanical shock, vibration, and fatigue tests were satisfactory. An increase of the cross-modulation performance was obtainable only at the cost of some other performance characteristics or input requirements. G.G.

N65-11140# Lincoln Lab., Mass. Inst. of Tech., Lexington
RANDOM NOISE CONSIDERATIONS IN THE DESIGN OF MAGNETIC FILM SENSE AMPLIFIERS Group Report 1964-6
H. Blatt 17 Aug. 1964 63 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-365; AD-605323)

A model of a magnetic film sense system is presented. Using the model, the mean time between false readouts due to random noise is determined as a function of the system parameters—total magnetic flux switched, switching time, sense line resistance, amplifier noise factor, and linear amplifier filter efficiency. (The filter efficiency with respect to a given input pulse shape is the signal-to-noise ratio at the output of the amplifier divided by the corresponding signal-to-noise ratio at the output of a filter matched to the pulse shape.) The degradation of signal-to-noise ratio caused by introduction of a quick recovery "short" time constant is determined and shown experimentally. Author

N65-11155# General Electric Co., Owensboro, Ky. Tube Dept.
C-BAND TRIODE-CAVITY OSCILLATORS, PRODUCTION ENGINEERING MEASURE Quarterly Progress Report, 1 Mar.–29 May 1964
J. D. Marshall [1964] 39 p
(Contract DA-36-039-AMC-01474(E))
(QPR-4; AD-605330)

Special test equipment is described. The test facility has been inspected, and was found to be acceptable. The second engineering sample was submitted. Modifications to the test specification were discussed. Preparations for entering the preproduction phase have been completed. Author

N65-11156# Michigan U., Ann Arbor Electron Physics Lab.
BASIC RESEARCH IN MICROWAVE DEVICES AND QUANTUM ELECTRONICS Quarterly Progress Report No. 5, 1 May–1 Aug. 1964
H. K. Detweiler, M. E. El-Shandwily, B. Ho, J. E. Rowe, and C. Yeh Aug. 1964 45 p
(Contract NObsr-89274)
(Rept.-05772-5-P; AD-447313)

A new frequency multiplier tube that will have a better overall conversion efficiency has been designed. The enhancement in efficiency is derived from the fact that a section of dc pumped quadrupole amplifier is added to boost the feedback signal to a workable level before introducing it onto the input coupler. Theoretical calculation indicates that enhancement in efficiency up to 100% can be realized. The technique for loading a helix into a BeO tube is being developed and the best test has proven it to be moderately successful. Equations for the modulation products of two-signal analysis of the amplitude- and phase-modulated traveling-wave amplifier have been programed and computed. Experimental results on the measurement of an X-band traveling-wave amplifier with two inputs are presented. Author

N65-11162# Compagnie Générale de Télégraphie sans Fil, Orsay (France) Centre de Physique Electronique et Corpusculaire

RESEARCH ON NOISE IN CROSSED FIELD DEVICES First Quarterly Technical Status Report

F. Diamand 31 Dec. 1963 44 p refs

(Contract DA-91-591-EUC-3120)

(WR-1161; AD-448497)

This report is concerned with noise measurements carried out on tube 530-A-5, that is similar to 530-A-4, except for the following modifications. The screen-gridded gun has been replaced by a short space charge gun. The line is provided with localized attenuation. The solo became accidentally distorted. The gun has been designed for a current of about 200 μA, but in spite of localized attenuation, the tube became instable for a current of about 80 μA. Therefore noise measurements have been carried out under anormal operating conditions of the gun.

Author

N65-11163# Compagnie Générale de Télégraphie sans Fil, Orsay (France) Centre de Physique Electronique et Corpusculaire

RESEARCH ON NOISE IN CROSSED FIELD DEVICES Second Quarterly Technical Status Report

F. Diamand Apr. 1964 10 p

(Contract DA-91-591-EUC-3120)

(WR-1190; AD-448708)

The noise figure obtained by a short space-charge gun was studied. The cathode surface area was reduced by a factor of 3, its length being 10 mm, and its width being 0.5 mm. The cathode was then mounted in a shorter tube. A reduction of the noise figure was not observed at a current of about 65 mA, which is the theoretical optimum for a magnetic field of 550 gauss. It was concluded that a space-charge gun does not provide a useful noise figure in the case of a power tube.

G.G.

N65-11164# Compagnie Générale de Télégraphie sans Fil, Orsay (France) Centre de Physique Electronique et Corpusculaire

RESEARCH ON NOISE IN CROSSED FIELD DEVICES Third Quarterly Technical Status Report

F. Diamand Jul. 1964 20 p refs

(Contract DA-91-591-EUC-3120)

(WR-1220; AD-448709)

Detailed measurements of the noise figure obtained with a gridded gun are presented. The characteristics of the grid used are as follows: bar diameter is 0.09 mm; distance between bars is 0.7 mm; and cathode to grid distance is 0.3 mm. The bars are parallel to the smaller side of the cathode that has a length of 15 mm and a width of 1.5 mm. The tube line length is 15 mm. Results are presented, showing that a noise figure lower than 50 dB can be obtained with acceptable tube power and efficiency when the grid voltage is low and the anode voltage is high. The noise figure was found to vary little with the magnetic field. Comparisons of these results with those obtained earlier for a space-charge gun using the same tube show that the gridded gun is more advantageous for low-noise applications.

M.P.G.

N65-11167# Corning Glass Works, Bradford, Pa. Electronic Products Div.

NF RESISTOR FACTORIAL LOAD LIFE TEST Combined Interim Development Report and Resistor Performance Report, Jul.–Oct. 1963

Stouder C. Thompson and Henry K. Gensler 30 Sep. 1963 127 p refs

(Contract NObsr-87385)

(AD-424847)

This project is concerned with the performance of a factorial load life test on hermetically sealed, glass NF resistors. The results of this test are in the form of detailed load life performance data. Resistors of two rated power dissipating capabilities, 0.125 W and 0.250 W have been tested. In this factorial test, approximately 21 000 resistors have operated at combinations of temperatures of 70°, 100°, 125°, and 150° C, and power dissipating levels of one time, two times, three times, four times, and five times their normally rated power for 2000 hours. In addition, 450 resistors have been tested for over 6000 hours and will continue to be under test up to 10 000 hours at 70° C under rated dissipating power. The analysis of performance is presented as follows: (1) Study of Failure Rates; (2) Determination of Acceleration Factors; (3) Effect of Stress—Failure Analysis; and (4) General Performance—Aging Characteristics.

Author

N65-11168# Edgerton, Germeshausen and Grier, Inc., Boston, Mass. Tube Research and Development Dept.

DEVELOPMENT OF A SUPER POWER DEUTERIUM THYRATRON Fifth Quarterly Report, 14 Jun.–15 Sep. 1964

N. Reinhardt 21 Sep. 1964 12 p

(Contract NObsr-89405)

(B-2901; AD-447384)

Five prototype tubes were evaluated, and two tubes were life tested. All seven tubes had cathodes that include a large surface-area heater; the coated heaters were vacuum fired at extremely high temperatures prior to assembly; and the tube envelopes were vacuum fired as subassemblies immediately preceding final assembly. Performance studies of the tubes indicated that the tubes have a wide (±15% average) operating range, have a stable T_{ad} (time of anode delay) and a low emission drop, and operate successfully at 45 kV. From the data obtained in evaluating and life testing the tubes, it is concluded that a reliable 45-kV superpower deuterium thyratron tube has been developed.

P.V.E.

N65-11187# Cornell-Dubilier Electric Corp., New Bedford, Ceramic Div.

PEM FOR PRODUCTION OF FLUORINATED BARIUM TITANATE CAPACITORS FOR OPERATION TO 200°C Quarterly Report, Ending 27 Jul. 1964

Paul C. Ricard [1964] 12 p

(Contract DA-36-039-SC-85955)

(QR-13; AD-605753) OTS: $1.00

Ceramic capacitors capable of operating at 200° C were developed from a fluorinated dielectric of which $BaTiO_3$ was the predominant material. The mature dielectric was fluorinated by refiring in a fluoride atmosphere. Silver wire leads, thin glass encapsulation, and an outer encapsulation by a zirconium-silicate-filled silicone system were used in the manufacturing of the fluorinated capacitors. This construction met all physical, electrical, and environmental tests satisfactorily in several 1000-hour life tests.

G.G.

N65-11239# Microwave Electronics Corp., Palo Alto, Calif.

DEVELOPMENT OF PPM-FOCUSED LOW-NOISE TRAVELING WAVE TUBES FOR K_u, K-, and K_a-BAND Interim Development Report, 1 Jul.–30 Sep. 1963

Oct. 1963 25 p

(Contract NObsr-89323)

(IDR-1; AD-604995) OTS: $1.00

Work during the reporting period included the following tasks. The initial gun design was completed. Jigs, fixtures, and special straightening techniques were made for cathode-gun alinement. The rf performance of the tubes was studied, and a gold-plated helix design was chosen. The helix characteristic impedance variation for rf matching was studied, and the resultant impedance transformer design produced VSWR < 2 from 10.5 to 16.5 Gc for four matched helices. The rf tests of existing MEC K_u- and K_a-band tubes provided reference data for tube design. (Modification of current MEC tubes will be possible.) Preliminary design of the PPM-focusing array was completed. Author

N65-11294# Microwave Associates, Inc., Burlington, Mass.
MINIATURIZED X-BAND STRIPLINE DUPLEXER Fourth Quarterly Progress Report, 1 Apr.–30 Jun. 1964
Robert H. Brunton [1964] 22 p
(Contract DA-36-039-AMC-03230(E))
(Rept.-4; AD-447928)

The component modules of the stripline duplexer, the stripline limiter, and a three-port circulator are discussed. The input and output connectors of the stripline limiter have been improved by using coaxial connectors. A new stripline limiter body has been designed, and data show significant improvement. Preliminary results have been obtained on the low level performance of single and two stage limiters in the new limiter body design. A three-port stripline ferrite circulator has been purchased, and tests indicate satisfactory operation for use in the dual mode duplexer (duplexer for use with the dual mode transmitter tube). Author

N65-11321# Michigan U., Ann Arbor Electron Physics Lab.
RESEARCH AND DEVELOPMENT ON HIGH-POWER CRESTATRONS FOR THE 100-300 MC FREQUENCY RANGE Quarterly Progress Report No. 13, Jul. 1–Oct. 1, 1963
G. T. Konrad Oct. 1963 30 p
(Contract NObsr-81403)
(Rept.-03783; AD-424128)

Several trajectory plots obtained in the design of the P_μ = 20 hollow-beam gun are described. A number of 100-W Crestatrons have been tested. Several methods of increasing the power output of these tubes are described. They are an improvement of the electron gun and the rf matching sections. Author

N65-11330# Universidad Autonoma de San Luis Potosi (Mexico) Escuela de Ingenieria
INITIAL STUDIES ON THE EXECUTION OF A FREQUENCY CHANGE FROM 50 TO 60 CYCLES PER SECOND IN AN ELECTRICAL SYSTEM [ESTUDIOS INICIALES PARA LA EJECUCION DEL CAMBIO DE FRECUENCIA DE 50 A 60 CICLOS POR SEGUNDO DE UN SISTEMA ELECTRICO]
Fernando Sosapavon Estrada 1964 90 p refs In SPANISH

The study has for its object the determination of the convenience of interconnecting the three principal electrical systems (Michoacan–Chapala–Guanajuato, Puebla–Veracruz, and Central) of the Mexican Republic, through an evaluation of the savings that would be obtained by operating the considered systems as a whole, in comparison with operating the same systems separately. D.E.W.

N65-11338# McCoy Electronics Co., Mount Holly Springs, Pa.
CRYSTAL UNITS WITH IMPROVED TEMPERATURE CHARACTERISTICS Quarterly Report, 1 Jan.–31 Mar. 1963
[1963] 60 p Prepared jointly with Bendix Corp.
(Contract DA-36-039-SC-90820)
(QR-3; AD-424493)

Three different techniques are being evaluated as a means of compensating an AT-oriented resonator. Most of the effort has been concentrated on the electronic compensation approach, with ten experimental models completed. A procedure for deriving compensation-network design data, utilizing a computer, has been developed to eliminate trial and error methods of determining component values. Thermal response characteristics of electronically compensated units are also discussed briefly, with initial results presented. In addition, progress on the external-force compensation and temperature variable-capacitor compensation technique is described. Author

N65-11340# Utah U., Salt Lake City Microwave Devices Lab.
CYCLOTRON WAVE DEVICES STUDY Third Quarterly Progress Report, Jan. 1–Mar. 31, 1964
T. Kao, D. C. Watson, C. H. Durney, C. C. Johnson, and R. W. Grow [1964] 25 p
(Contract DA-36-039-AMC-02372(E))
(Rept.-3; AD-447429)

The S-band amplifier was tested extensively. High small-signal gains were obtained and low insertion losses have been observed. Optimum operation of the amplifier has not been obtained as the operating characteristics appear to be very sensitive to the focusing conditions. The coupled-mode analysis, modified to account for space charge and beam rotation, has shown that the coupling is quite complex, involving several cyclotron and synchronous idlers and longitudinal velocity and displacement modes. A solution has been obtained that gives the results of space charge. Author

N65-11344*# Westinghouse Electric Corp., Baltimore, Md.
DESIGN AND TESTING OF REDUNDANT SYSTEMS
H. Brinker and A. R. Helland Sep. 1963 *In its* Res. on Failure Free Systems Nov. 1964 94 p refs (See N65-11343 02-10) OTS Prices: HC $3.50/MF $1.25

Results of a study on the implementation of majority logic redundancy are presented. Most of the work concerns spaceborne systems, but some portions are applicable to ground support equipment. A discussion of the possible use of magnetic logic to reduce the total power consumption and to provide nonvolatile storage includes a description and comparison of various types of semiconductor logic for redundant systems. Integrated diode–transistor elements are chosen as the most suitable for general use. A discussion of the detection and location of failures includes several methods of testing redundant systems and solutions to failure-detection problems of varying complexity. It is shown that the use of a redundant system greatly increases system reliability and reduces the requirements for test equipment and operator skill. Techniques that permit a major portion of the maintenance to be performed during normal system operation are described. M.P.G.

N65-11346*# Westinghouse Electric Corp., Baltimore, Md.
A SURVEY OF COMPONENTS FOR ADAPTIVE RESTORING CIRCUITS
H. Brinker *In its* Res. on Failure Free Systems Nov. 1964 17 p refs (See N65-11343 02-10) OTS Prices: HC $3.50/MF $1.25

The usefulness of the Adaline neuron approach in implementing the adaptive voting elements of a redundant system is investigated. The use of adaptive voters to extend the reliability of a conventional redundant system, by using 9 replicas to outperform a conventional system using 35 replicas of each function, is charted. Training rules for Adaline neurons modified and applied as adaptive voters are shown to be relatively

simple. Inherent in the design of an adaptive voter is the requirement for a variable weighted device that performs integration and has a relatively permanent memory. A survey of efforts to develop suitable adaptive components exploiting electrochemical or magnetic phenomena indicates that none of the suggested adaptive devices were sufficiently developed to justify the selection of a practical approach for immediate circuit implementation of an adaptive voter. M.P.G.

N65-11355# Microwave Associates, Inc., Burlington, Mass.
UHF DUPLEXERS Final Progress Report, Nov. 1963–May 1964
Henry Griffin and Sumner Segal [1964] 66 p
(Contract NObsr-89105)
(AD-601881) OTS: $3.00

A three-port ferrite circulator was developed that successfully demonstrated a power handling capability of 500-kW peak power and 10-kW average power. The insertion loss is less than 0.5 dB over the band 400 to 450 Mc. For receiver protection after the ferrite circulator, a solid-state diode limiter was developed. The insertion loss of the limiter is less than 0.8 dB over the 400- to 450-Mc band. A power handling capability of 150-kW peak and 1.5-kW average was demonstrated with a 60μsec pulse width. A leakage power of 300-mW peak was obtained with no spike leakage. For the 200- to 225-Mc-band, a complete solid-state diode limiter has been achieved that can successfully switch 200-kW peak power, 10-kW average power, with a 200μsec pulse width. A transmit loss of 0.1 dB and receive loss of 2.0 dB was obtained with a leakage power of 50-mW peak to the receiver. Author

N65-11356# Raytheon Co., Burlington, Mass. Spencer Lab.
STUDY AND CORRECTION OF SPURIOUS POWER OUTPUT (RK6344 MAGNETRON) Quarterly Engineering Report No. 4, 22 Apr.–22 Jul. 1964
P. S. Bottoriff [1964] 24 p ref
(Contract NObsr-89518)
(Pt-778; QR1248-Q4; AD-605181) OTS: $1.00

This is a study of tubes using integral wideband output filters as an effective means of spurious signal suppression, of tubes with nonstandard slanted-vane shapes for the reduction of the third harmonic signal level, and of methods for combining the various tube structures into one signal tube. The wideband filter design produced a marked reduction in spurious levels in the 8° to 2° Gc range, including a 35-dB attenuation of the second harmonic and a 20-dB minimum attenuation of the third harmonic levels. Computer calculations showed that only small changes in harmonic power levels can be expected by altering the vane shapes. The use of 15° slanted vanes with standard tubes caused a decrease of about 7 dB in the third harmonic level, but produced no changes in the second harmonic level. However, a spurious resonance was observed in the tubes using slanted vanes, which resulted in a sharp drop in the circuit efficiency and unstable behavior in hot operations. Below 10^{-7}-mm Hg gas pressure, a change of up to 10 dB in the noise levels was observed, depending on the sampling frequency. G.G.

N65-11357# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION ENGINEERING MEASURE ON TRANSISTOR, POWER, 400 MC, 300 MW, STEP 1 Quarterly Report, Jun. 23–Sep. 23, 1964
R. A. Jacobs and J. L. Lemons [1963] 30 p
(Contract DA-36-039-SC-85975)
(QR-9; AD-424464)

Specifications for new germanium, uhf power transistors capable of delivering 300 mW of output power at 400 Mc are presented. This device underwent destructive testing, and some severe yield problems have been improved for the surface quality, the doping profiles, and the epitaxial layer thickness. A safe-area pulse test has been developed to demonstrate the capability of the devices to withstand a collector voltage of 30 V and a minimum current of 0.5 A, with the voltage applied as a pulse to prevent overheating. A new transmission-line oscillator circuit with external feedback has been devised to improve the ruggedness and efficiency of the device. G.G.

N65-11368# Microwave Associates, Inc., Burlington, Mass.
SOLID-STATE GENERATOR Quarterly Report, 1 Jun.–31 Aug. 1964
Ernst F. Scherer [1964] 19 p refs
(Contract NObsr-89356)
(QR-5; AD-606088)

The following investigations pertaining to the development of a solid-state rf generator are reported: (1) development of an S-band tripler for the last multiplier stage based on the design concepts of an integrated idler circuit and line-coupled, multisection, broadband filters; (2) the development of 1- and 3-Gc multisection broadband filters for the tripler; and (3) studies of variations in design concepts concerning the power amplifier and multipliers. Specifically, the design problem is whether to use two transistors in either parallel or push–pull operation to obtain the required 500 Mc/sec frequency or to start at 330 Mc/sec and use a tripler instead of a doubler as the first stage. M.P.G.

N65-11385# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
DEVELOPMENT OF A LOW NOISE—LOW DISTORTION TRANSISTOR Final Engineering Report
John E. Muschinske and Fred A. Rubi [1963] 51 p ref
(Contract NObsr-87438)
(AD-299252)

Two devices were developed—an npn silicon, epitaxial, planar, small-area, low-current, very-high-frequency transistor and a pnp silicon, epitaxial, planar, large-area, high-current, high-frequency transistor. Both devices provide considerable improvement in intermodulation distortion and comparable noise figure performance over germanium devices presently used in this application, but fall short of the objectives set forth in the specifications. Author

N65-11394# National Co., Inc., Malden, Mass.
PRODUCTION ENGINEERING MEASURE FOR CESIUM BEAM TUBES Quarterly Progress Report, 23 Aug.–23 Nov. 1963
James George [1963] 32 p
(Contract DA-36-039-AMC-01457)
(QPR-2; AD-604413)

The program is defined and divided into component tasks. The tasks performed involved the fabrication, assembly, and test of the first two (PEM-E1 and PEM-E2) of six engineering-model cesium-beam tubes. Performance characteristics and test data are presented. In addition, the design changes to be incorporated in the third (PEM-E3) and fourth (PEM-E4) cesium beam tubes are discussed. Author

N65-11425# Hughes Aircraft Co., Newport Beach, Calif. Electronic Products Div.
SSB AND VHF CRYSTAL FILTERS Quarterly Report, 15 Mar.–15 Jun. 1964
E. C. Ho and R. H. Tuznik [1964] 65 p refs
(Contract DA-36-039-AMC-02305(E))
(QR-4; AD-450176)

Suitable ten-crystal, two-section half-lattice models at 2 and 5 Mc have been fabricated, and test results are presented. An equimotibnal 10-crystal narrowband filter at 10.5 Mc has been designed and tested. Additional computations were performed on the ladder crystal filter, and new approaches utilizing the analytic design technique were devised. An initial design of the 30-Mc third-overtone crystal is presented. Author

N65-11427# Tung-Sol Electric, Inc., Livingston, N.J. Chatham Electronics Div.
ELECTRON TUBES RADIATION RESISTANT PILOT LINE PRODUCTION Quarterly Progress Report, 21 May–31 Aug. 1963
J. Grimm and F. B. Parks 30 Sep. 1963 74 p
(Contract DA-36-039-AMC-01476(E))
(QPR-1; AD-425708)

An rf heated work station was designed and constructed for the purpose of making stems. Carbon molds for each of the four tube types designated were designed and fabricated. Upon receipt of the aluminosilicate glass and nickel–molybdenum–nickel leads, the work station and forming molds were successfully evaluated, and the feasibility was established of the stem design, as well as the equipment. Indicated improvements such as higher rf power at the work, better quality of stems, and closer control over sealing techniques, were made to both equipment and tube fabrication as a result of continued efforts. Author

N65-11498*# General Precision, Inc., Glendale, Calif. Librascope Group
TEST PERFORMED BY LIBRASCOPE RELIABILITY DEPARTMENT ON RADIO FREQUENCY CONNECTORS
L. Hayn 24 Sep. 1964 83 p
(Contract NAS7-100)
(NASA-CR-59806; TR-7-0075) OTS Prices: HC $3.00/MF $0.75

This report presents the results of a test program comparing the mechanical and electrical characteristics of radio-frequency connectors when subjected to a sequence of environments. Samples from eleven different manufacturers were subjected to thermal shock, altitude, humidity, and salt spray. The test results clearly demonstrated similar characteristics between the subminiature, miniature, and regular rf connector types. Nearly all connector types exhibited a steady electrical degradation of the insulation resistance parameter during exposure to humidity, and especially to salt-spray environments. Author

N65-11512# Union Carbide Corp., Parma, Ohio Linde Div.
DEVELOPMENT OF THIN ORGANIC ROLLED FILM CAPACITOR Progress Report, 1 Jul.–30 Sep. 1964
D. J. Valley [1964] 27 p
(Contract NObsr-89519)
(QPR-5)

Progress in developing a thin, organic, rolled film capacitor, using ML-1 film as the dielectric material, is reported in the following areas: (1) foils, including substrate preparation, surface decontamination, mechanical smoothing, and electropolishing; (2) coated-foils evaluation; (3) development of a new slitting machine; and (4) process development, including changes in the standard process, adjustment of winding tension, terminations, tests in various atmospheres, and conditioning. M.P.G.

N65-11542# General Dynamics/Pomona, Calif.
HIGH SPEED FERRITE PHASE SHIFTERS
Raymond F. Mix *In* AFSC 13th Ann. Symp.: USAF Antenna Res. and Develop. Program [1963] 12 p refs (See N65-11526 02-07)

The selection of candidate ferrites for high-speed conical-scanning antennas is described, and a few methods to reduce the shorted turn effect are discussed. The best results obtainable for high-speed ferrite phase shifters are obtained by using an extremely thin metal wall on a dielectric body. The walls should be as thin as possible, depending on the ac drive frequency, without exceeding the microwave skin depth. The power required to drive a phase shifter at these high scan rates is dependent on wall thickness. Examples are given. D.E.W.

N65-11607# Microwave Associates, Inc., Burlington, Mass. Solid-State Circuits Div.
BROADBAND SOLID-STATE SWITCHES Fourth Quarterly Report, 1 Apr.–30 Jun. 1964
L. Nathanson [1964] 14 p
(Contract NObsr-89463)
(AD-606695)

This report contains data pertaining to high-power measurements of an X-band prototype and to six radially mounted diodes in a 6.25-ohm line section. Also, VSWR performance data on the eight-section 50- to 6.25-ohm matching transformers for L/S-band are presented. Author

N65-11672# General Electric Co., Auburn, N.Y. Rectifier Components Dept.
A PRODUCTION ENGINEERING MEASURE FOR THE IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY FOR DIFFUSED SILICON CONTROLLED SWITCHES TYPES 2N689 Quarterly Progress Report, 1 Jul.–30 Sep. 1964
J. N. Frank, A. Hishta, R. C. Rome, H. Wawrousek, and W. R. Comstock [1964] 27 p refs
(Contract DA-36-039-AMC-03619(E))
(QPR-S; AD-608240)

This report covers the work performed on the ultrasonic welding of the package main seal, the optimization of tabulation weld schedules, the fabrication of the complete device assembly integrated into existing production lines, and the summary of a step-stress test at full-load operating conditions on the all-diffused device. A PERT analysis depicts the progress of this program and provides for certain conclusions based upon the work performed. Author

N65-11673# Westinghouse Electric Corp., Elkridge, Md. Molecular Electronics Div.
PRODUCTION ENGINEERING MEASURE Quarterly Report, Apr. 1–Jun. 30, 1964
Hauw T. Go [1964] 37 p
(Contract DA-36-039-AMC-03617(E))
(QR-4; AD-607473)

The processes of diffusion, photochemistry, assembly, encapsulation, and design were improved in order to increase the reliability of the silicon planar transistor and of the microelectronic monolithic circuitry. Thermal step-stress tests were completed up to the 300° C level, and extensive parameter studies were performed. G.G.

N65-11682# Naval Research Lab., Washington, D.C. Radar Div.

A SOLID STATE LOGARITHMIC VIDEO AMPLIFIER FOR PULSE APPLICATIONS Interim Report

R. L. Slice 11 Aug. 1964 8 p refs

(NRL-6147; AD-605192)

A logarithmic amplifier has been designed for a data-sampling system used in connection with a radar system. The amplifier was designed primarily for pulse inputs of positive polarity with a pulse width of 1μsec to 2μsec and a pulse repetition frequency of 5.46 kc. One outstanding feature of the amplifier is its simplicity. The design incorporates no complicated feedback arrangements to achieve the desired logarithmic characteristics. Author

N65-11686# American Electronic Labs., Inc., Colmar, Pa.

VIDEO DETECTOR DIODES FOR COUNTERMEASURES EQUIPMENT Final Development Report, 1 Mar.–31 Aug. 1964

15 Sep. 1964 29 p

(Contract NObsr-89357)

(AD-447450)

A mathematical analysis of the small-signal theory of the detection sensitivity of crystal diodes is presented, and the relationships between the diode equivalent-circuit parameters and fabrication processes are discussed. Factors that influence the design of a high-power, high-sensitivity video diode are considered, particularly in regard to the design of a structure that will adequately dissipate the heat generated by CW- and transient-signal operation. Details of the variations in device geometry and materials, and their effect on the finished unit are also discussed. Steps leading to the finalization of the package design are outlined, and the final package is described. Test setups for the measurement of tangential sensitivity, VSWR, and power-handling capability (CW, DC pulsed, and RF pulsed) are described. The test results are presented in tabular form. Author

N65-11723# Microwave Electronics Corp., Palo Alto, Calif.

DEVELOPMENT OF PPM-FOCUSED LOW-NOISE TRAVELING-WAVE TUBES FOR K_u-, K-, AND K_a-BAND Interim Development Report 4, 1 Apr.–30 Jun. 1964

Sep. 1964 15 p

(Contract NObsr-89323)

(MEC-QTR-NObsr-89323-4; AD-606321)

Work to develop three different types of periodic-permanent-magnet (PPM) focused low-noise traveling-wave tube amplifiers, covering the frequency range of 10.5 to 38 Gc, is reported. The achievement of 11-dB-maximum broadband noise figure for the k_u-band tube, covering the frequency range from 10.5 to 16.5 Gc, was obtained in PPM stack; two prototype PPM stack and packages were constructed; and PPM stack and compact package design concepts used in k_u- and K-band tubes were applied to the design of a K_a-band tube stack and package. M.P.G.

N65-11795# Utah U., Salt Lake City. Microwave Device and Physical Electronics Lab.

A TEN KILOMEGACYCLE AMPLIFIER UTILIZING THE INTERACTION BETWEEN A PERIODIC ELECTRON BEAM AND AN UNLOADED WAVEGUIDE MODE

W. L. Dickson and C. C. Johnson. Wright-Patterson AFB, Ohio, AF Avionics Lab., Sep. 1964 119 p refs

(Contract AF 33(657)-8677)

(ASD-2; AL-TDR-64-192; AD-607395)

This paper describes the theoretical concept, the construction, and the experimental results of an amplifier that utilizes a waveguide as the propagating circuit. The interactions take place between a spiraling electron beam and the dominant waveguide mode in the presence of an axial magnetic field. The amplifier is designed to operate under pulsed conditions at X-band. It was found that theoretical gains in the order of 10 dB, with efficiencies of 30 percent are possible; however, only small gains were obtained experimentally. G.G.

N65-11799# Tung-Sol Electric, Inc., Livingston, N.J. Power Tube Div.

PRODUCTION ENGINEERING MEASURE FOR TYPE 7890 SUPER POWER HYDROGEN THYRATRON Ninth Quarterly Progress Report, 8 Mar.–7 Jun. 1964

C. L. Shackelford [1964] 18 p

(Contract DA-36-039-SC-85984)

(Rept.-9; AD-605329)

Satisfactory tests for four tubes were obtained. An increase in grid overlap did not cause significant change in grid firing. Grid current was reduced by the addition of cooling fins to the external grid rings. Author

N65-11820# Raytheon Co., Waltham, Mass. Research Div.

HIGH FREQUENCY TUNNEL DEVICE STUDY

S. R. Steele and A. Starr Griffiss AFB, N.Y., RADC, Sep. 1964 38 p refs

(Contract AF 30(602)-3249)

(RADC-TDR-64-285; AD-608037)

Measurements of the lifetimes of Al-Al_2O_3-Au tunnel cathodes have been obtained with pulse durations varying from 200 μsec to 100 msec, with duty cycles ranging from 0.001 to 0.1 and with sandwich current densities ranging from 0.5 A/cm^2 to 5 A/cm^2. As the testing proceeded the devices usually showed increased efficiencies for a time, then a rapid deterioration. At constant sandwich voltages, the sandwich currents generally remained approximately constant during the early stages of life, then gradually increased. The data showed some consistency when the emission current at constant voltage was plotted against the total charge passing through the device. From the standpoint of life gold does not seem to be a very satisfactory metal for the counterelectrode. Some devices were made using palladium (mp 1550° C) instead of gold (mp 1060° C) as the counterelectrode. Fabrication of iridium (mp 2550° C) devices is in progress. Author

N65-11889# Radio Corp. of America, Camden, N.J. Applied Research Dept.

CERENKOV MICROWAVE GENERATOR Final Technical Documentary Report, Dec. 1963–Jul. 1964

A. Boornard, J. M. Brumbaugh, J. J. Stekert, and L. W. Zelby Griffiss AFB, N.Y., RADC, Oct. 1964 72 p refs

(Contract AF 30(602)-3061)

(RADC-TDR-64-403; AD-608218)

Measurements have been made of the cw Cerenkov radiation generated by the interaction of a modulated ribbon electron beam with a dielectric reflection coupler. The coupler consists of two identical 1.27-cm-wide slab sectors having an interaction length of 10 cm. The dielectric coefficient of the coupler material is 15 at the beam modulation frequency of 6.33 Gc. Typical experimental parameters are dc beam current, 0.30 mA; gun voltage plus potential well voltage, 70 kV; bunch rf power, 1.0 W; and beam-to-dielectric separation, 0.16 cm. Separating the contribution of leakage radiation and resonance radiation from the detected power level gives 4.6 μW as the detected Cerenkov power for a typical experimental determination. The generated-to-detected power ratio is determined to be between 165 to 75. Using the calculated value of the beam current amplitude at 6.33 Gc yields 1250 to 560 ohms/cm for the interaction resistance per unit length. The value

of 1250 ohms/cm is in good agreement with the interaction resistance predicted by the theory developed in previous work. Author

N65-11893# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Microwave Research Inst.
HIGH-FREQUENCY COMPENSATION OF TRANSISTORS
S. Deutsch, J. G. Corbellini, D. C. Greenberg, and A. M. Horn Aug. 1964 27 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1234-64; AFOSR-64-1831; AD-608131)

If a relatively small-collector-load resistor is used so that the gain of a transistor stage is low, the addition of a peaking coil yields substantial improvements in bandwidth or rise time. Still further improvements result from the use of a peaking capacitor in addition to the coil. Normalized values of L and C are derived for critically damped, transient, maximally flat amplitude and maximally flat delay designs. The associated response curves are given. Author

N65-11928# General Motors Corp., Kokomo, Ind. Delco Radio Div.
NON-DESTRUCTIVE RELIABILITY SCREENING OF ELECTRONIC PARTS Final Report
J. R. Bevington and L. V. Ingle Griffiss AFB, N.Y., RADC, Sep. 1964 245 p refs
(Contract AF 30(602)-2972)
(RADC-TDR-64-311; AD-608137)

An extensive study of the relationship of a large number of parameters to later failure was made for germanium, high-power, pnp, alloy junction transistors. The relative effectiveness of several screening approaches was tested, and applications to several related device types were made to extend the applicability. A reliability screening technique that uses the time response characteristic after step application of rated diode voltage was developed. A study of the mechanism of collector diode degradation failure resulted in the establishment of a model for the mechanism of failure. A computer program was developed and is described. Author

N65-11966# General Electric Co., Owensboro, Ky. Tube Dept.
FEASIBILITY STUDY OF TIMM POWER TRIODE Technical Documentary Report, 1 Jul. 1963–May 1964
Robert M. Hughes et al Wright-Patterson AFB, Ohio, AF Avionics Lab., Oct. 1964 61 p
(Contract AF 33(657)-12329)
(AL-TDR-64-230; AD-607531)

The objective of this program was to determine the feasibility of a TIMM triode in the 10-watt class. The relative merits of both the planar and the cylindrical design were investigated. Processing and assembly steps were developed. Experimental tubes of each design were constructed and evaluated for electrical characteristics and performance under swept frequency vibration, shock, and life-test conditions. The feasibility of both designs was demonstrated, and some problem areas were defined. Author

N65-11985# United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.
ENHANCED MICRO-MODULE INTERCONNECTIONS: AN HERMETIC PACKAGING SYSTEM FOR THE INTEGRATION OF MICRO CIRCUITS Fourth Quarterly Report, 1 Apr.–30 Jun. 1964
R. Collins and D. J. Garibotti 4 Jan. 1964 41 p refs
(Contract DA-36-039-AMC-03620(E))
(HSER-3027; AD-605490)

Fifteen engineering-model design-enhanced micromodules were assembled with materials and techniques which, in general, reflect the ultimate production environments. These units were tested for thermal shock, vibration, mechanical shock, and leak. Ten 10-stage binary-divider enhanced micromodules were also assembled and tested. These modules demonstrated the compatibility of the interconnection-packaging system with solid-state integrated circuits. The electroplated portion of the terminated microwafer was increased in length from 0.005 to 0.009 inches to eliminate "opens" that were occurring during stack welding. Author

N65-12021*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN ANALYSIS OF THE VARIATION IN WEAR LIFE OF HOT PRESSED MOLYBDENUM DISULFIDE-SILVER ELECTRICAL CONTACT BRUSHES IN VACUUM
Donald R. Ulrich 5 Oct. 1964 24 p refs
(NASA-TM-X-53146) OTS Prices: HC $1.00/MF $0.50

Compositions of hot-pressed molybdenum disulfide containing metallic additions have shown promise as materials for electrical contact brushes in vacuum; however, the wear life for a given composition has varied from specimen to specimen. The nonreproducibility of these brushes has been analyzed with the major effort being concentrated on a 55.9% MoS_2–44.1% Ag (wt) composition. The factors affecting wear duration of both the brush materials and their deposited commutator films have been studied and correlated. An optimum brush composition that should give the best combination of lubrication and electrical conduction properties is defined. The brushes are classified according to their electrical conduction behavior. Author

N65-12050# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
SECONDARY BREAKDOWN, RADIATION RESISTANCE AND FREQUENCY RESPONSE OF SILICON TRANSISTORS
Bernard Reich and Edward B. Hakim Jun. 1964 10 p refs
(USAEL-TR-2463; AD-607561)

In choosing devices to withstand a particular environment, care must be taken to insure that compromises are not made with respect to other important performance requirements. In this report the interplay of secondary breakdown performance and the resistance of the transistor to neutron radiation is described. For the optimum choice of a transistor with respect to both the secondary breakdown and neutron radiation-resistance performance, the transistor with the highest possible gain bandwidth product is not the best choice. It has also been shown that in addition to the initial static assessment of the combined requirements, the dynamic situation must also be considered. Secondary breakdown will, in itself, vary with neutron radiation. Author

N65-12052# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
MATERIAL PROCESSING AND PHENOMENA INVESTIGATIONS FOR FUNCTIONAL ELECTRONIC BLOCKS Interim Engineering Report, 6 Mar.–6 Jun. 1964
I. M. Mackintosh [1964] 46 p ref
(Contract AF 33(657)-9897)
(IER-7; AD-603176) OTS: $3.00

Slight contamination of an n-type dopant from anodic solutions using nitrite salts was drastically reduced, but was not eliminated. The best results were obtained using potassium nitrite. The substitution of calcium nitrite gave no further improvement. A complementary pnp–npn transistor structure was produced by the diffusion of boron from the gas phase

and phosphorus from anodic oxides. The high-field triode structure was examined with the scanning electron microscope, and the existence of an inversion layer under the gate electrode of these devices under bias was shown. This confirmed the mechanism of operation of these devices that was predicted by theory. A simple baking process was established that restores the devices to their original electrical characteristics. It was shown that the manual alinement of electron-beam exposure of photoresist for the gates of insulated-gate field-effect transistors, where the channel width is less than 3 microns, is feasible. D.E.W.

N65-12059# Texas Instruments, Inc., Dallas Semiconductor Components Div.
DEVELOPMENT OF A TRANSISTOR DELIVERING AN OSCILLATOR OUTPUT OF 250 MILLIWATTS AT 1.5 GIGACYCLES Final Engineering Report, Jun. 28, 1963–Jun. 28, 1964
29 Sep. 1964 44 p
(Contract NObsr-89423)
(Rept.-03-64-65; AD-606313)

The unsuccessful development of germanium transistors is described, and the design, development, and production of silicon transistors that can handle 250 milliwatts at 1.5 Gc/sec are reported. Masks were designed for a four-transistor device, and their fabrication from silicon is described. Some were mounted in an older type of package, and, when the new coaxial package was ready, the rest of the transistors were mounted in it. Testing of the first group revealed insufficient power due to high contact capacity and resistance in the leads. When these defects had been corrected, the devices fully met the requirements. D.E.W.

N65-12060# ITT Industrial Labs., Fort Wayne, Ind.
IMPROVED QUANTUM EFFICIENCY LASER DETECTORS Interim Engineering Report
E. H. Eberhardt and J. L. Gumnick 9 Oct. 1964 56 p refs
(Contract AF 33(615)-1596)
(AD-606680)

The optical properties of thin films and arrays of thin films to be used as photocathodes, as well as their overall photoexcitation and emission phenomena, are being investigated. Also, the development of an electron multiplier that is to be associated with a laser detector is discussed. Work on photocathodes includes theoretical analysis, experimental results and procedures, stock tubes, special tubes, and vidissector tubes. A discussion of electron multiplier improvement includes reducing the number of stages of electron multipliers and improving anode geometry, resistive end plates, first dynode, and front end geometry, and advanced anode geometry. P.V.E.

N65-12065# Hughes Research Labs., Malibu, Calif. Material Sciences Lab.
ENHANCED BOMBARDMENT INDUCED CONDUCTIVITY STORAGE TARGET FOR MEMORY TUBES Interim Engineering Report, 1 Apr.–30 Jun. 1964
N. H. Lahrar [1964] 34 p refs
(Contract AF 33(615)-1128)
(IER-2; AD-605188) OTS: $2.00

A preliminary analysis was made of the SEBIC data by comparison with models based on barriers formed by metal-to-semiconductor contacts and p-n junctions. The capacitance of the SEBIC layer in the back-biased condition varies in proportion to the inverse of approximately the one-third power of the applied voltage. The volt–ampere characteristic indicates that the reverse current tends to saturate when the applied voltage is of the order of a few volts. These data imply that a barrier region is formed that has a high donor density in the bulk SEBIC dielectric; the data are consistent with those of a barrier produced by graded p-n junctions rather than a metal-to-semiconductor contact. The SEBIC layer fabrication techniques were studied. In particular, experiments were conducted to determine the optimum thermal processing time and temperature for fabricating SEBIC layers exhibiting the most sustained change in conductivity for the longest time. Author

N65-12129# Stanford U., Calif. W. W. Hansen Labs. of Physics
MULTIMEGAWATT BROADBAND MICROWAVE TUBES Quarterly Status Report No. 10, 1 Feb.–30 Apr. 1964
Marvin Chodorow Griffiss AFB, N.Y., RADC, Sep. 1964 41 p
(Contract AF 30(602)-2575)
(RADC-TDR-64-357; AD-607450)

Progress is reported in the following areas: (1) Centipede TWT—Current results of theory and experiment are presented. (2) Periodic Circuit Studies—Modifications of existing circuits and new circuits for high-power TWT's for improvement of bandwidth, impedance, and stability are investigated. Evaluation of an unshielded periodic array of small dielectric resonators as a positive-dispersion slow-wave structure providing an axial H-field is presented. (3) Extended Interaction Klystrons—Assembly of an experimental three-cavity tube has been completed. (4) Transverse Wave Studies—Investigation of transverse wave propagation on an accelerated stream is continuing. Author

N65-12179# Mictron Inc., Albany, N.Y.
C.W. X-BAND VOLTAGE TUNABLE MAGNETRON Fourth Quarterly Progress Report, 1 Apr.–30 Jun. 1964
M. R. Boyd and M. Weinstein [1964] 17 p
(Contract DA-36-039-AMC-03270(E))
(Rept.-4; AD-448714)

Modification of the initial tube designs in the direction indicated by the rf performance was undertaken. Circuit work in conjunction with the modified tubes was also carried out. Experimental work was curtailed because of conducting films on ceramics. This difficulty has been resolved, and further modifications are being made and evaluated. Author

N65-12244# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J. Radar Div.
HIGH RANGE RESOLUTION COHERENT RADAR
Samuel E. Craig Jun. 1964 24 p refs
(USAEL-TR-2496; AD-608038)

An experimental coherent radar was assembled to investigate the value of high range resolution, without comparable azimuthal resolution, in differentiating between natural targets and manmade targets. A pulsed varactor diode in a microwave switch was used to modulate the output of a cw klystron. The peak power output was about 100 mW. The best range resolution obtained was about three feet. Since the system used coherent detection, any target motion appeared quite clearly on the A-scope presentation. A distinct difference could be seen between the return from a steadily moving target, such as a vehicle, and the return from an irregularly moving target, such as a tree branch or foliage swaying in the wind. Author

N65-12263# Edgerton, Germeshausen and Grier, Inc., Boston, Mass.
PHOTOGRAPHIC RECONNAISSANCE TERRAIN ILLUMINANTS Interim Engineering Report

P. Bruce Newell and A. B. White 30 Sep. 1964 48 p ref
(Contract AF 33(657)-11327)
(B-2904; AD-607704)

Investigations of liquid-cooled tubular xenon suitable for use as continuous (dc) sources for night terrain illumination is discussed. Work has been done on the design of a water-cooled 7-mm bore, 3-in.-arc-length lamp. Investigation has also been conducted into the material and configuration for suitable electrodes, the low rfi starting methods, the spectral measurement of the output of such a lamp, and the design and fabrication of a tailored-beam reflector. The tailored-beam reflector, a contoured trough with end plates, is to provide a 4° by 60° beam pattern with light intensities essentially evenly distributed in the final film plane. Measurements of the spectral output and luminous efficiency of the dc xenon lamp revealed that the continuum is apparently quite uniform from 400 mμ to 1200 mμ, with several very strong lines in the infrared. P.V.E.

N65-12269*# National Aeronautics and Space Administration, Washington, D.C.
METHODS OF DECREASING THE TIME CONSTANT OF INPUT CIRCUITS OF ELECTROMETRIC AMPLIFIERS [METODY UMEN'SHENIYA POSTOYANNOY VREMENI VKHODNOY TSEPI ELEKTROMETRICHESKIKH USILITELEY]
A. V. Parshin, N. N. Romanova, and L. B. Ustinova Nov. 1964 18 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), No. 3, May–Jun. 1964 p 88–94
(NASA-TT-F-9192) OTS Prices: HC $1.00/MF $0.50

Two methods of compensation are described for the transient characteristics of electrometric amplifiers—negative feedback with a compensating filter, and positive feedback. Both methods make it possible to obtain approximately the same rise time for the signal at the output. The reasons for limiting the decrease in the rise time and the possibilities of their elimination are discussed. Author

N65-12270*# National Aeronautics and Space Administration, Washington, D.C.
EIGEN NOISE IN WIDE-BAND ELECTROMETRIC AMPLIFIERS [SOBSTVENNYY SHUM SHIROKOPOLOSNYKH ELEKTROMETRICHESKIKH USILITELEY]
N. N. Romanova, A. V. Parshin, and L. B. Ustinova Nov. 1964 17 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), no. 3, May–Jun. 1964 p 94–102
(NASA-TT-F-9193) OTS Prices: HC $1.00/MF $0.50

The eigennoise of wideband electrometric amplifiers is computed. The conditions for obtaining maximum sensitivity are determined. The effect of the parameters of the input circuit, of the tube, and of the type of scheme on the value of the maximum sensitivity is considered. Author

N65-12271*# National Aeronautics and Space Administration, Washington, D.C.
ELECTROMETRIC AMPLIFIERS USING SUBMINIATURE TUBES [ELEKTROMETRICHESKIYE USILITELI NA SUBMINIATYURNYKH LAMPAKH]
A. V. Parshin and L. B. Ustinova Nov. 1964 13p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), no. 3, May–Jun. 1964 p 102–107
(NASA-TT-F-9194) OTS Prices: HC $1.00/MF $0.50

Four versions of electrometric amplifiers with subminiature tubes are discussed. The band pass in three of these amplifiers is increased from 40 to 160 cps with an input resistance of 100 G ohms. Technical data concerning the amplifiers are presented, and some special features concerning the design of economical miniature amplifiers by the use of semiconductor devices are discussed. Author

N65-12292# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE THIRD CONCURRENCE OF THE ELECTRONIC TUBE
M. Rostarchuk 17 Aug. 1964 6 p Transl. into ENGLISH from Sovet. Belorussiya (Minsk), no. 55, 6 Mar. 1962 p 4
(FTD-TT-64-366/1; AD-605799)

This paper discusses the development and possible use of electrochemical converters (i.e., elements operating in accordance with the laws of electrochemistry) and their advantages over electrons. Electrochemical equipment consumes 100 to 1000 times less energy than semiconductor equipment, and at the same time is more sensitive and precise, more reliable, and less complex in construction. The use of electrochemical cells in attempts to reproduce cerebral processes is suggested. G.G.

N65-12329# Atomic Energy of Canada Ltd., Chalk River, Ontario
LOW-NOISE, CHARGE-SENSITIVE, VACUUM TUBE PREAMPLIFIER FOR SEMICONDUCTOR DETECTORS
A. J. Tavendale Sep. 1964 12 p refs
(AECL-2071; CRGP-1182) Available from Atomic Energy of Canada, Chalk River, Ontario: $0.50

The design and performance of a low-noise, charge-sensitive vacuum tube preamplifier for semiconductor detectors are described. The preamplifier has a noise figure of 1.8-keV FWHM-germanium equivalent of 270 rms electron-hole pairs at zero load capacitance. The slope of the noise versus input load capacitance characteristic is 0.4-keV FWHM-germanium equivalent per pF. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-10956# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
THE PULSE-POSITION MODULATION OF A LIGHT EMITTING GALLIUM ARSENIDE DIODE
George Dewey Locke, Jr. (M.S. Thesis) Aug. 1963 48 p refs
(GE/EE/63-15; AD-421431)

The gallium arsenide diode is one of the most efficient semiconductor light emitters in use today. Like all semiconductor devices, however, it can dissipate only small amounts of power. This severely limits the range over which the radiation from a GaAs diode can be detected. By using pulse-position modulation, high-current pulses of short duration can be used to modulate the light and maintain low-power dissipation. This significantly increases the range obtainable. The complete transmitter for this scheme contains only five or six transistors, depending on the maximum current limit of the diode used. Author

N65-10967# Utah U., Salt Lake City Microwave Devices and Physical Electronics Lab.
MICROWAVE DEVICE AND PHYSICAL ELECTRONICS LABORATORY Consolidated Quarterly Report, 1 Apr.–30 Jun. 1964
L. S. Bowman et al 30 Jun. 1964 118 p refs
(Contract Nonr-1288(05); AF 33(657)-8677; AF 04(693)-439; DA-36-039-AMC-02372(E))
(MDL-Q9; AD-605418)

Studies of electron-beam devices, solid-state devices, and plasmas are reported in an effort to extend the useful frequency spectrum into the range from microwave frequencies to optical frequencies, as well as to improve existing devices and techniques in the microwave spectrum. The electron-beam studies include a 36- to 40-kMc multiple-ladder circuit backward-wave oscillator, dielectric slow-wave circuits, rotating beam devices, a cyclotron wave device, multiple-beam interactions, magnetoelectric beam compression, transverse beam waves, and a 2-mm backward-wave oscillator. Quantum studies include irradiated laser materials, tunneling studies, millimeter-wave masers, and gas-laser studies. Plasma studies include waves in plasmas, plasma generation and measurements, plasma for a coupling medium, rocket-exhaust studies, and superconductivity. M.P.G.

N65-10995# Office of Naval Research, Washington, D.C.
MICROELECTRONIC PROBLEM AREAS AND RESEARCH NEEDS
Aug. 1964 18 p refs
(AD-606064)

The following microelectronic research problems are reviewed and discussed: "Process Technology and Materials"—compatability, high-temperature environment, radiation environment, large-area devices, substrates for thin-film use, effects of residual gases, and the structure of thin films; "Device Characteristics"—the greater variety of components and devices, thin-film active devices, the increased range of values, improved tolerances, micropower and macropower devices, and high frequency; "Circuit Techniques"—design and reliability; and "Interconnection and Packaging." G.G.

N65-11009# Utah U., Salt Lake City Microwave Devices Lab.
IMPEDANCE AND PROPAGATION CHARACTERISTICS OF A FOUR COUPLED-LADDER BACKWARD-WAVE OSCILLATOR WITH NONZERO PITCH
Lawrence S. Bowman and Richard W. Grow 10 Aug. 1963 60 p refs
(Contract Nonr-1288(05))
(ONR-TR-6; AD-423921)

A general discussion of the theory of backward-wave oscillators is presented, and the propagation and impedance characteristics are determined for a backward-wave oscillator having a circuit consisting of four coupled ladders placed across the narrow dimension of a waveguide. Propagation curves and impedance curves are presented for both the fundamental forward- and the backward-wave components for several values of pitch and ladder plane spacing. A larger pitch or ladder plane spacing increases the frequency corresponding to a given phase constant. Author

N65-11011# Illinois U., Urbana Coordinated Science Lab.
OPTIMAL MATCHING OF NONLINEAR n-PORT NETWORKS
R. A. Rohrer and J. P. Herner Jul. 1964 24 p refs
(Contract DA-28-043-AMC-00073(E))
(R-221; AD-605419)

The classical calculus of variations is applied to find the conditions for maximum energy transfer in nonlinear n-port networks. The general matching problem is discussed, and the sufficient conditions for the optimal load network are given in terms of the time domain behavior of the network. The optimal match for a tunnel diode is given as a specialization of the general results. Author

N65-11024# Joint Publications Research Service, Washington, D.C.
POSSIBILITIES OF USING GALVANOMAGNETIC SWITCHES IN LOGICAL CIRCUITS
N. A. Khokhlacheva 23 Nov. 1964 9 p refs Transl. into ENGLISH from Radiotekhn. (Moscow), v. 19, no. 8, 1964, p 70–74
(JPRS-27501; TT-64-51750)

A new method is offered for conducting logical operations, consisting of the replacement of complex switching devices by simple, small devices, i.e., by logical micromodules. Experimental data typifying the work of certain galvanomagnetic logical devices are presented. Author

N65-11126# Cornell U., Ithaca, N.Y. Electrical Engineering Research Lab.
REVIEW OF A RESEARCH EFFORT IN ACTIVE NETWORK THEORY Interim Report
N. De Claris and S. K. Mitra Aug. 1964 154 p refs
(Contracts AF 33(657)-10682; AF 33(615)-1274)
(EERL-14; ALTDR-64-180; AD-607081)

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3. REALIZATION OF TRANSFER FUNCTIONS OF RC: TUNNEL-DIODE NETWORKS David L. Losee 1 p
4. TRANSFER-FUNCTION REALIZATION USING NONIDEAL NEGATIVE IMPEDANCE CONVERTERS G. Hurtig, III 66 p refs (See N65-11127 02-10)
5. A POLYNOMIAL DECOMPOSITION APPROACH TO THE SYNTHESIS OF DRIVING-POINT FUNCTIONS J. F. Delansky 55 p refs (See N65-11128 02-10)
6. MULTIPORT STRUCTURES CONTAINING TUNNEL DIODES S. K. Mullick 19 p refs (See N65-11129 02-10)

N65-11127# Cornell U., Ithaca, N.Y. Electrical Engineering Research Lab.
TRANSFER-FUNCTION REALIZATION USING NONIDEAL NEGATIVE IMPEDANCE CONVERTERS
Gunnar Hurtig, III *In its* Rev. of a Res. Effort in Active Network Theory Aug. 1964 66 p refs (See N65-11126 02-10)

In practice, the ideal negative-impedance converter can only be approximated, and it is shown that the resulting nonideal behavior affects the transfer function and must then be taken into account in the design procedure. Extensions to the transfer-function synthesis methods of Linvill and Yanagisawa are presented, allowing the designer to precorrect the passive portion of the RC:NIC network to account for the nonideal negative-impedance converter. The sensitivity of Linvill circuits is discussed, and it is shown that it is possible to obtain a zero in sensitivity that is independent of frequency if certain restrictions are placed on the NIC parameters. Examples of precorrection are given. Author

N65-11128# Cornell U., Ithaca, N.Y. Electrical Engineering Research Lab.
A POLYNOMIAL DECOMPOSITION APPROACH TO THE SYNTHESIS OF DRIVING-POINT FUNCTIONS
J. F. Delansky *In its* Rev. of a Res. Effort in Active Network Theory Aug. 1964 55 p refs (See N65-11129 02-10)

Two decompositions of a polynomial, in a complex variable, representing the transmission zeros of a lossless, linear, lumped, finite, passive, and bilateral coupling network are considered. The existence and nonuniqueness of the two decompositions are shown, and some methods of constructing them are given. Applications of the decompositions in the synthesis of driving-point functions for passive and active networks are discussed. By the examples given, it is shown that the nonuniqueness of the decompositions may sometimes be exploited to obtain a superior network realization. Specifically, it is shown that applying either decomposition to the numerator polynomial of the even part of a positive real function allows a Darlington-type synthesis without augmentation. Author

N65-11129# Cornell U., Ithaca, N.Y. Electrical Engineering Research Lab.
MULTIPORT STRUCTURES CONTAINING TUNNEL DIODES
S. K. Mullick *In its* Rev. of a Res. Effort in Active Network Theory Aug. 1964 19 p refs (See N65-11126 02-10)

An effort to extend Sandberg's work giving necessary and sufficient conditions for the realizability of multiport structures obtained by imbedding a single tunnel diode in a lossless reciprocal network is reported. These results are extended to permit network structures that are not necessarily reciprocal and to consider the case where more than one tunnel diode is imbedded in a lossless structure. The major result to date is the statement of a theorem and its proof. The extension to the multitunnel diode case is discussed, and an example of the theorem is described. M.P.G.

N65-11171# Illinois U., Urbana Digital Computer Lab.
AN INCREMENTAL CHARGE METHOD FOR THE ANALYSIS OF NONLINEAR CIRCUITS
Stephen John Nuspl (M.S. Thesis) 6 Aug. 1964 82 p refs (Contract Nonr-1834(15))
(Rept.-166; AD-605293) OTS: $3.00

A method of analysis is developed in which only one of Kirchkoff's laws is assumed to hold, i.e., it is assumed that the current law holds and that the voltage law may be violated. To obtain sufficiently simple numerical formulas, the circuit is restricted to the tree-topology type. The basic charge distribution and node-voltage calculation formulas are derived for the general branch that may consist of a resistance, a capacitance, an inductance, a voltage source, or any series combination of these. Since this method favors current controlled nonlinear elements, an analogous but more restricted method for including voltage-controlled devices is developed. A brief discussion of errors, their compensation, and their stability is included. Techniques by which diodes, transistors, and transmission lines may be handled are also described. A program written for the IBM-7094 system based on this method is presented, and results for four sample circuits are given. D.S.G.

N65-11190# Illinois U., Urbana Coordinated Science Lab.
AN EXTENSION OF DASHER SYNTHESIS
Bruce D. Elliott Aug. 1964 45 p refs
(Contracts DA-28-043-AMC-00073(E); AF 49(638)-1383) (R-231; AD-605420)

A study is given of conditions under which a specified nonminimum phase transfer function may be realized as a cascade of common terminal RC structures, each of which realizes a pair of complex zeros. Specifically, conditions are derived that must be satisfied by a driving point admittance, if a section producing a pair of zeros in a portion of the right half plane is to be removed and an RC function is to remain. The simplest section parameters consistent with this objective are chosen, and inequalities are derived that assure positive solutions for the unspecified constants. A technique is also derived for the conversion of the complete admittance description of a common terminal section to a physical network based on node insertion in the admittance matrix, and sufficient inequalities are given. Author

N65-11197# New York U., N.Y. Lab. for Electroscience Research
CONTROL SYSTEMS Final Report, Mar. 1, 1962–Sep. 30, 1963
S. S. L. Chang and J. Ragazzini (1964) 23 p refs
(Grant AF-AFOSR-62-321)
(AFOSR-64-1005; AD-602685) OTS: $1.00

The following basic theoretical problems were studied, and their solutions are presented: "Relative Improvement Evaluation for a Class of Self-Adaptive Systems"; "The General Theory of Digital Filters with Applications to Spectral Analysis"; "Noise and Random Processes"; "Minimal Time Control with Multiple Saturation Limits"; "The Approximate Realization of Optimum Control System"; "Optimal Control in Bounded Phase Space"; "Adaptive Information Processing"; "A Modified Maximum Principle for Optimum Control of Systems with Bounded Phase Coordinates"; "Justification and Limitation of a Two-Parameter, Two-Adjustment, Self-Adaptive System"; and "Power Spectrum Identification for Adaptive System." G.G.

N65-11281# Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON ALL-MAGNETIC LOGIC TECHNIQUES Final Report
D. R. Bennion Nov. 1963 16 p refs
(Contract Nonr-2712(00))
(AD-424614)

The objectives, and accomplishments of this project on all-magnetic logic techniques are reviewed. The 5 technical reports on the project work are listed, with abstracts. A few recent results of scheme studies on all-magnetic circuits are summarized. Author

N65-11343*# Westinghouse Electric Corp., Baltimore, Md.
RESEARCH ON FAILURE FREE SYSTEMS Final Report
Washington, NASA, Nov. 1964 236 p refs
(Contract NASw-572)
(NASA-CR-105) OTS Prices: HC $3.50/MF $1.25

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1. DESIGN AND TESTING OF REDUNDANT SYSTEMS H. Brinker and A. R. Helland 94 p refs (See N65-11344 02-09)

2. RELIABILITY OF IMPERFECT REDUNDANT SYSTEMS R. S. Bray, P. A. Jensen, and C. G. Masters 21 p ref (See N65-11345 02-10)

3. A SURVEY OF COMPONENTS FOR ADAPTIVE RESTORING CIRCUITS H. Brinker 17 p refs (See N65-11346 02-09)

4. TRANSOR ANALYSIS R. S. Bray, P. A. Jensen, and C. G. Masters 27 p refs (See N65-11347 02-10)

5. COMPARISON OF DYNAMIC AND THRESHOLD RESTORERS C. G. Masters and R. S. Bray 32 p refs (See N65-11348 02-10)

6. SELF REPAIR TECHNIQUES M. R. Cosgrove and C. G. Masters 41 p refs (See N65-11349 02-10)

N65-11345*# Westinghouse Electric Corp., Baltimore, Md.
RELIABILITY OF IMPERFECT REDUNDANT SYSTEMS
R. S. Bray, P. A. Jensen, and C. G. Masters Sep. 1963 *In its* Res. on Failure Free Systems Nov. 1964 21 p ref (See N65-11343 02-10) OTS Prices: HC $3.50/MF $1.25

Although the ability of redundant systems to withstand a number of internal failures and still function successfully is desirable from a reliability standpoint, it increases the problems associated with prelaunch and inflight tests, and makes unreasonable a decision on whether to continue a given mission solely on the fact that a system is operating at the time of the test. A limited number of tests to be made just before the start of the mission are proposed in order to determine the number and location of initial failures and the failure rates of the circuits that comprise the system. Procedures for obtaining a statistical estimate of the probability of mission success with varying degrees of accuracy are proposed, as is a procedure for making a decision on the usability of the system without estimating the mission reliability. Details of these procedures are still incomplete, and their relative usefulness has not been evaluated; therefore, this report should serve only as a basis for further studies. M.P.G.

N65-11347*# Westinghouse Electric Corp., Baltimore, Md.
TRANSOR ANALYSIS
R. S. Bray, P. A. Jensen, and C. G. Masters Sep. 1963 *In its* Res. on Failure Free Systems Nov. 1964 27 p refs (See N65-11343 02-10) OTS Prices: HC $3.50/MF $1.25

A new adaptive restoring organ called the Transor is described. In this logic element, steady-state outputs (the dominant failure mode of many failed subsystems) are automatically deweighted by detecting only changes in states rather than the absolute states themselves. Thus, in an environment where the probability of steady-state failure is relatively high, the Transor can derive a correct output with less than a majority of working inputs. The Transor restoring circuit is diagramed, and the salient characteristics of the Transor restoring organ are contrasted to the characteristics of a majority restoring organ. The maximum error restoring capability of Transor is shown to be R-1 failures of R redundant lines in an environment free from transitional failures; however, in environments where symmetrical transitional errors are possible, error correlation may make Transor performance inferior to threshold. A general Transor reliability model and a decision rule for determining an optimum threshold are in preparation. M.P.G.

N65-11348*# Westinghouse Electric Corp., Baltimore, Md.
COMPARISON OF DYNAMIC AND THRESHOLD RESTORERS
C. G. Masters and R. S. Bray Dec. 1963 *In its* Res. on Failure Free Systems Nov. 1964 32 p ref (See N65-11343 02-10) OTS Prices: HC $3.50/MF $1.25

In the course of determining a ratio of probability of steady-state to transient errors for an evaluation of the Transor relative to threshold voters, a new dynamic restoring circuit was developed that has obvious advantages over the Transor for certain input failure-pattern conditions. This circuit, the Hamming Distance Restoring Circuit, was included in the investigation. Results are reported for the evaluation of it relative to the Transor as well as to the threshold voter. The conclusions are these: (1) The output of the Hamming Distance Circuit is more reliable than that of the Transor in order-five redundant systems for any ratio of error probability or any asymmetry. (2) The threshold circuit is more reliable than either of the dynamic restoring circuits until the probability ratio of steady-state to transient errors exceeds approximately 7:1. (3) In the short-life, high-reliability region with approximately a 7:1 probability ratio, an order-five system using Hamming Distance Restorers may be as reliable as an order-seven system using threshold voters. M.P.G.

N65-11349*# Westinghouse Electric Corp., Baltimore, Md.
SELF REPAIR TECHNIQUES
M. R. Cosgrove and C. G. Masters Sep. 1963 *In its* Res. on Failure Free Systems Nov. 1964 41 p ref (See N65-11343 02-10) OTS Prices: HC $3.50/MF $1.25

This report contains a description of the several classes of repair strategies under consideration and the computer simulation program used to determine the performance of the systems for each strategy. The computer simulation program determines the performance of a particular strategy by injecting random failures throughout the system and simulating system reaction according to the repair pattern of the strategy in question. The program prints out system performance in terms of total time to failure, average time to failure, number of failures to system failure, and number of switches affected. The results for the two classes of strategies for which curves were drawn show that with the addition of a minimal amount of self-repair capability, the reliability of the system can be substantially increased over that of a comparable system using fixed redundancy alone for failure protection.
Author

N65-11353# University of Southern Calif., Los Angeles School of Engineering
TWO CLASSES OF OPTIMUM LINEAR SYSTEMS Interim Technical Documentary Report
Nasser E. Nahi Nov. 1963 23 p refs
(Contract AF 04(695)-304)
(USCEE-101; SSD-TDR-63-386; AD-424503)

A problem is considered in which one source supplies all the fuel, and the constraint may be the limit on the total rate of consumption of fuel. The time history of the thrusts in the case of a space vehicle was determined in order to transfer the problem from an initial condition—such as a set of values for initial position, velocity, and acceleration—to a final state—such as a desired set of values for the same quantities. Two classes of linear systems are presented: (1) those systems for which the optimum control function is identical under two constraints of bounded power and bounded total energy; and (2) systems for which the optimum control function with a bounded power constraint can be approximated, with a desired accuracy, by the control function with a "modified" total energy constraint. The exact solution for the case of bounded power is presented, and the solution corresponding to a "modified" total energy constraint was approximated by the optimal control vector of a multistep process, each step having a bounded energy constraint. G.G.

N65-11626# Rensselaer Polytechnic Inst., Troy, N.Y.
PHYSICAL PHENOMENA FOR LOGICAL FUNCTIONS Final Technical Report
Walter R. Beam 15 Feb. 1964 41 p refs
(Grant AF-AFOSR-62-194)
(AFOSR-64-1379; AD-604046)

The following studies are presented: "Distributed Constant Neuristors"; "Niobium Oxide Negative Resistance Elements"; "Minimum Complexity Digital Electronics"; "Continuous-Medium Domain Logic and Memory Devices"; and "Remarks on Topology and Power Supply of Logical Networks." Also presented are the following appendixes: "Theory of Distributed-Constant Neuristor Operation"; "Complete Neuristor Device Configurations"; and "A Tunneling Model for Negative Resistance Oxide Films." G.G.

N65-11674# Microwave Associates, Inc., Burlington, Mass. Solid-State Circuits Div.
BROADBAND MICROWAVE POWER LIMITERS Quarterly Report, 1 Jul.–30 Sep. 1964
L. Nathanson [1964] 32 p
(Contract NObsr-89462)
(QR-5; AD-608054)

The effects of the value of the coupling-loop terminating resistor are discussed, and experimental data pertaining to four L/S-band coupling loops are presented. Data are also included with reference to low-level and high-power measurements of fourteen PIN limiting diodes in the 6.25-ohm line section of the L/S-band limiter. Author

N65-11699# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.
CHARACTERIZATION OF SQUIB MK 1 MOD 0: SENSITIVITY TO 9 GC RADAR IN THE NEAR FIELD
Gary P. Carver Dec. 1964 35 p refs
(NOLTR-64-117; AD-451120)

Power delivered by a radar set at 9 Gc was coupled to the Mk 1 squib by using the squib leads as $3/2\lambda$ dipoles placed at the mouth of a microwave horn. Bridgewire temperatures were measured by injecting dc current at the rf voltage null points on the dipoles. Temperatures for firings averaged 230° C; 400° C was expected. Though some temperature oscillograms showed normal thermal stacking, there were many cases indicating variation of coupling or internal flow of rf energy. Author

N65-11765# Space Sciences, Inc., Waltham, Mass.
CATHODE PHENOMENA IN THE LOW PRESSURE MERCURY ARC Final Report
S. B. Afshartous, P. Felsenthal, W. E. Knabe, J. M. Proud, and C. G. Smith Griffiss AFB, N.Y., RADC, Sep. 1964 71 p refs
(Contract AF 30(602)-3093)
(RADC-TDR-64-306; AD-607732)

In this experimental investigation, the cathode emission and retrograde motion phenomena were studied for the low-pressure anchored mercury arc. Results were obtained from optical measurements of the arc spot size, its optical radiation properties, and its motion about a mercury-wetted anchor in the presence of a strong magnetic field. The shape and spectral emission of the arc column have also been examined. Theories were proposed to account for the retrograde motion. A heat balance model of the arc spot was suggested to account for some of the experimental observations, and a modified thermionic emission process was proposed to account for the observed emission current density. Author

N65-11878# Spectrolab, Inc., Sylmar, Calif.
DESIGN AND FABRICATION OF OPTICAL FILTERS FOR LASER FREQUENCY Technical Documentary Report, Feb. 1963–Jul. 1964
Samuel J. Holmes and Noel E. Bowman Wright-Patterson AFB, Ohio, AF Avionics Lab., Oct. 1964 71 p refs
(Contract AF 33(657)-9216)
(AFAL-TR-64-268; AD-608064)

Theoretical aspects, production methods, and evaluation techniques of narrowband optical filters, which employ a thin sheet of mica in place of the usual evaporated dielectric spacer layer, are described. Such filters have been made and are reported with half-widths of less than 2 Å and with transmission on the order of 60%. In particular, details are given of the method of cleaving the mica sheets and the measurement of absorption. A filter holder is described that makes it possible to construct filters of practical size. Theoretical and experimental values are given for the angular sensitivity. Other properties discussed are the tunability, background, the spectral region for which they can be constructed, and the stability of the filters with time and with temperature changes. Author

N65-11984# Autonetics, Anaheim, Calif.
FAULT ISOLATION OF ELECTRONIC CIRCUITS USING TRANSFER FUNCTION METHODS
J. E. Valstar Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Oct. 1964 195 p refs
(Contract AF 33(615)-1070)
(APL-TDR-64-123; AD-608176)

Dynamic testing techniques based on operational calculus or transformation methods are potentially capable of extracting deterministic information about the status of a system for its input and output. Methods have been studied that, by means of linear transformations of input and output, generate numerical information about the polynomial coefficients in numerator and denominator of the system's transfer function. A unifying theory covering all methods based on the linear transformations has been developed. Of specific interest are methods where the transformations are mechanized by means of physical networks (transformation filters), because of their possible simplicity and their real-time properties. The simplest transformation filter is a low-pass RC network that basically performs a leftsided Laplace transformation. Author

N65-12033# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
OPTIMUM CONTROL WITH FEEDBACK SIGNAL DELAY
N. N. Krasovskiy 3 Sep. 1964 25 p refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), v. 24, no. 8, 1963 p 1021–1036
(FTD-MT-64-40; AD-607910)

The problem of determining the optimum law of control ξ^*, minimizing integral appraisal of the quality of the process when there are random actions in the system, and the feedback signal delay is considered. The optimality criterion, based on the ideas of the Lyapunov method of functions and on principles of dynamic programming, is formulated. Effective calculation of control ξ^*, minimizing mean-square error, is described. Author

N65-12170# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Avionics Lab.
AN ACTIVE NETWORK FOR SYNTHESIS OF A CLASS OF RATIONAL FUNCTIONS
George R. Branner Sep. 1964 16 p refs
(AL-TDR-64-238; AD-608286)

This report contains three techniques for synthesis of active Resistance Capacitance (RC) networks. The circuit configuration is a modification of one originally proposed by Sandberg. Basic theorems of RC active network synthesis are utilized in the realizations. Numerical examples are given in each case. Author

N65-12198# California U., Berkeley Electronics Research Lab.
INTEGRATED UNIJUNCTION TRANSISTOR OSCILLATORS Technical Documentary Report, Jan.–Dec. 1963
G. Hachtel and G. Haines Wright-Patterson AFB, Ohio, AF Avionics Lab., 16 Jan. 1964 68 p refs
(Contracts AF 33(616)-7553; AF 33(615)-1045)
(AL-TDR-64-196; AD-606832)

Integrated near-harmonic oscillators based on unijunction transistor (UJT) action are investigated. Conditions for near-harmonic oscillation are established in a form appropriate to the treatment of integrated silicon oscillators. The fundamental

aspects of UJT action are examined, and a modeling procedure is proposed for use in integrated oscillator design. Finally, a complete design procedure for integrated UJT oscillators is presented and applied to the fabrication of planar diffused silicon realizations. The performance of these oscillators is discussed and compared with the performance of other lumped and integrable oscillators. Author

N65-12298 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
MICROWAVE RESEARCH INSTITUTE PROGRESS REPORT NO. 25, 1 OCTOBER 1963–31 MARCH 1964
Ernst Weber [1964] 159 p refs
(Grant AF-AFOSR-453-63)
(R-452.25-64; AD-601855) OTS: $3.00

Research projects included under the following six subject headings are summarized: "Electromagnetics"; "Plasma Electrophysics and Electronics"; "Solid-State and Materials Research"; "Microwave Circuits"; "Network Theory"; and "Systems, Communications, and Control." P.V.E.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-10959# Canadian Armament Research and Development Establishment, Valcartier
A HIGH PERFORMANCE EXPERIMENTAL SMOOTH BORE GUN
G. Bertrand, G. Gallagher, and J. J. Maroney Aug. 1964 27 p
(CARDE-TR-484/64)

This paper reports and discusses the results of hypervelocity firings of 1.0-, 2.0-, and 2.7-lb projectiles in a 3.2-in.-caliber gun. In general, ballistic parameters bearing on the maximization of muzzle velocity are reviewed: reference is made to pressure gradients observed to differ from the ones given by conventional internal ballistic theory. The effects of bore evacuation are recorded, and the use of light gases is discussed. Author

N65-10998# National Weather Satellite Center, Washington, D.C. Meteorological Satellite Lab.
AN ANALYSIS OF CDA STATION EFFECTIVENESS IN RELATION TO SATELLITE ORBIT
Robert L. Pyle and S. Fred Singer Jul. 1963 33 p
(MSL-18)

The effectiveness of any geographical location as a site for satellite data acquisition depends significantly on percentage of passes from which data may be acquired, elevation angles to the satellite during acquisition, and length of time available for acquisition during each pass. The geometric relationships are examined analytically to determine the dependence of station "effectiveness" on satellite altitude and orbital inclination. A single station at temperate or subpolar latitudes below 69° can never acquire data from every daily pass of an orbit with sun-synchronous inclination, regardless of satellite altitude. For any station, the percentage of passes acquirable from a sun-synchronous orbit is maximum when the satellite is near 1500-n.mi. alt. The velocity of injection into orbit must be accurate within ±45 ft. per second to achieve and maintain a sun-synchronous orbit for a period of several years. A station at 65° lat (Fairbanks, Alaska) can acquire data from every pass of a (nonsun-synchronous) 90°-polar orbit at all altitudes above 550 n.mi. For any station the percentage acquisition, average elevation angle, and length of acquisition time increase with increasing altitude; and at any altitude these parameters are maximum for a 90°-polar orbit. Author

N65-11049# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
PARAMETERS, TECHNIQUES, AND SIGNIFICANCE OF SOLAR SIMULATION IN SPACE SIMULATION TEST CHAMBERS
Donald E. Lee and Leo Steg Aug. 1964 49 p refs Paper Presented at the Fluid Dyn. Panel Meeting, AGARD, NATO, Marseilles, 20–24 Apr. 1964
(R64SD58; AD-604416)

A review of the significance of solar simulation (collimation, spectrum, etc.) on a typical satellite is given. Parameters affecting construction and performance of the solar-simulation system and its relationship to a large (32 ft × 54 ft) space chamber are presented. Performance data of the complete chamber and sun system, and early test results of typical satellite systems are reviewed. Author

N65-11066# Ohio State U. Research Foundation, Columbus
NONDESTRUCTIVE SYSTEM FOR INSPECTION OF FIBER GLASS REINFORCED PLASTIC MISSILE CASES AND OTHER STRUCTURAL MATERIALS Final Report
Jay P. Mitchell, Merle L. Rhoten, and Robert C. Mc Master Dec. 1963 148 p refs
(Contract DA-33-019-ORD-3670)
(WAL-TR-142.5/2-9; AD-445951)

A nondestructive test system has been developed for inspection of fiber glass and other rocket case materials. It utilizes a television imaging system to sense and display enlarged X-ray images with detail resolution of 10 microns or better. The system is capable of producing X-ray images with X-radiation intensities as low as 4 milliroentgens per image. Imaging with low X-radiation intensities is made possible by the use of an X-ray-sensitive television camera tube and a scan-converter image storage system. This combination of components and systems permits integration of weak image signals to useable levels. The system is capable of displaying 2% penetrameter contrast through 0.5 inch of steel and 2 inches of aluminum alloy. The image enlargement is approximately 30X. Author

N65-11095# Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXXVI. STUDIES OF THE QUALITY OF PETROLEUM COKE FROM A PILOT SCALE DELAYED COKER Technical Documentary Report, Jul. 1962–Apr. 1963
C. F. Stout, M. Janes, and J. A. Biehl Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1964 121 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. XXXVI; AD-606892)

This report describes the design, construction, and operation of an experimental delayed-coking unit for the conversion of petroleum residues to coke for use as the filler component in graphite for aerospace applications. The effect of changes in operating conditions of the experimental coker, e.g., time–temperature, pressure, and recycle ratio, was investigated with respect to the physical properties of graphitized, extruded, and molded samples. Four basic charge stocks were studied: vacuum residuum, slurry (decant) oil, thermal tar, and a low-sulfur thermal tar. Variations in raw-coke bulk density are

reported; in addition, data concerning kerosene density, ash, and sulfur content of the 1000° C calcined cokes are also included. Changes in bulk density, weight, and volume of the extruded and molded test samples resulting from the processing steps of baking and graphitizing are reported. Author

N65-11184# California U., Berkeley Lawrence Radiation Lab.
BEVATRON OPERATION AND DEVELOPMENT. 41, JANUARY–MARCH 1964
Kenneth C. Crebbin, Robert Frias, William L. Everette, and Walter D. Hartsough 29 Jul. 1964 29 p refs
(Contract W-7405-ENG-48)
(UCRL-11560) OTS: $2.00

The study of high-intensity beam loss continued. Changes in pole-face-winding currents increased the maximum accelerated beam to 5×10^{12} protons per pulse. Double pulsing of the rapid beam ejector was tried in preparation for simultaneous operation for two bubble-chamber experiments. One primary experiment was finished and three new primary experiments were set up and started operation. Low rate of rise of the magnetic field at low fields was tried, and the beam was successfully steered through this "mezzanine" region. Radiation background and activation studies continued. Author

N65-11213# RAND Corp., Santa Monica, Calif.
CURRENT CONCEPTS AND ISSUES OF IN-SPACE SUPPORT
Sidney I. Firstman Aug. 1964 12 p Submitted for Publication
(AD-606580)

The focus of this paper is on maintenance and checkout system concepts for manned space vehicles. Currently, there are two primary maintenance concepts: (1) modular design and in-flight repair, and (2) redundancy and switching. These are described, and the factors relating to their applicability are discussed. Checkout system concepts compatible with both maintenance approaches are similarly treated. The operational domains of interest are in the in-flight and lunar mission phases of the next set of manned space missions, typified by those of Gemini and Apollo. Author

N65-11246# Celestial Research Corp., South Pasadena, Calif.
PERFORMANCE RATING OF SPACE VACUUM SIMULATION CHAMBERS
Raymond L. Chuan [1964] 14 p refs Presented at the 1st Intern. Congr. on Vacuum Tech. in Space Res., Paris, 27 Jun.–4 Jul. 1964

After a discussion of self-contamination of test articles in a space chamber, and of pressure and molecular flux in a space chamber, it is concluded that the performance of the space simulation chamber, as rated by the self-contamination coefficient, is related to a measurable quantity—the impact pressure. In fact, the self-contamination coefficient is shown to be equal to the ratio of the impact pressure as measured with an orifice probe shielded from the source, to the impact pressure as determined by an orifice probe facing the source. D.E.W

N65-11247# Aircraft Research Assn., Ltd., Bedford (Gt. Brit.)
THE LAMINAR WIND TUNNEL OF THE INSTITUTE FOR AERODYNAMICS AND GASDYNAMICS, TECHNISCHE HOCHSCHULE, STUTTGART
F. X. Wortmann and D. Althaus Aug. 1964 10 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick, W. Germany), v. 12, no. 4, Apr. 1964
(ARA-7)

The tunnel is built as an open tunnel of the Eiffel design and is made virtually independent of weather conditions by means of wind barriers. The maximum velocity is of 91 m/sec. The rectangular working section with rounded corners measures 0.73 × 2.73 m. The instrumentation enables aerofoil section characteristics to be measured over a range of Reynolds numbers from 2.5×10^6 to 6×10^6. The results are processed by transducers and analog computers and are presented in the form of reduced values on a coordinate plotter. The extremely low turbulence level makes this tunnel ideally suited for investigation of all problems associated with laminar flow and with drag reduction due to laminarization. Author

N65-11261# RAND Corp., Santa Monica, Calif.
THE PREPARATION OF CAMPHOR MODELS FOR WIND-TUNNEL SUBLIMATION STUDIES. PRELIMINARY RESULTS ON THE SUBLIMATION OF A POINTED CONE
Andrew F. Charwat Jul. 1962 18 p refs
(P-2611; AD-604815)

The present preliminary study of techniques for the preparation of camphor and naphthalene models for experimental research on sublimation cooling in hypersonic flow has led to the development of a vacuum sintering technique that yields uniform, homogeneous, clear, and easily machinable samples. It is felt, on the basis of static and wind tunnel tests, as well as on the basis of these general observations, that models prepared in this fashion are well suited for accurate reproducible measurements of the history of subliming surfaces, and that they will provide reliable data. Further tests on the physical properties of the material (such as its shear strength, its specific heat, its thermoconductivity, and so on) are under way. A method for accurate measurement of surface temperature during the course of the destructive phase-change mass transfer process is proposed, and partly developed. Author

N65-11265# Joint Publications Research Service, Washington, D.C.
AN APPRAISAL OF THE WORKING CONDITIONS OF RADAR STATIONS OF THE CIVIL AIR FLEET
A. Ya. Loshak and Ye. F. Mar'yechkin 27 Nov. 1964 10 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), no. 7, 1964 p 39–44
(JPRS-27561; TT-64-51809) OTS: $1.00

The ultra high-frequency radiation environment of personnel at radar stations of the Russian Civil Air Fleet was evaluated. It was concluded that the engineering and technical staff of radar stations, in the course of work, is subjected to the influence of direct and dispersed uhf radiation of variable constancy, duration, and intensity, the levels of which may be from one to several microwatts per cm^2. Prevention of the harmful effects of microwaves on the staff of radar stations should be based on planning and organizational measures and on the use of protective measures. It is necessary to develop norms of permissible irradiation, taking into account periodicity, intensity, and frequency range of the effective uhf energy. High levels of uhf radiation, recorded from radar station antennas require the establishment of medical protection zones and of measurement methods. D.E.W.

N65-11268# Air Force Systems Command, Wright-Patterson AFB, Ohio Research and Technology Div.
CONSIDERATIONS AND ANALYSIS OF A PROPOSED ELECTROSTATIC HYPERSONIC WIND TUNNEL Technical Documentary Report, Jun.–Sep. 1963
Kenneth E. Vickers and Gary Culp Oct. 1963 33 p refs
(RTD-TDR-63-4067; AD-423707)

An analysis of the parameters concerning a proposed electrostatic wind tunnel for simulation of high velocities and high altitudes was undertaken. This hypersonic wind tunnel would provide a nonthermal means for simulating hypersonic flow in which the fluid is accelerated by the application of an

electric field. Some of the problems involved with the concept, the development of the wind tunnel, and the possible limitations of the system are discussed. Requirements for the simulation of velocities between 10^2 and 10^4 m/sec at altitudes from 50 to 160 km are identified. Analysis of the proposed electrostatic wind tunnel suggests a lower limit for altitude simulation in the range 75 to 100 km for velocities between 10^3 and 10^4 m/sec. Author

N65-11288# Eidgenossisches Flugzeugwerk Emmen (Switzerland)
THE FATIGUE HISTORY SIMULATOR DEVELOPED BY F + W EMMEN
Jürg Branger 17 Apr. 1964 23 p refs Presented at the 2d Seminar on Fatigue and Fatigue Design, Columbia U., N.Y., 5 May 1964
(T-197)

The essential features of the new test facility are the absolute proportionality of the load distribution and the genuine sequence of the loading. The paper describes the hydraulic jacks, the load maintainer, and the electronic control and supervision, and the capabilities of the test facility. Author

N65-11379# Melpar, Inc., Falls Church, Va.
SIMULATION OF HELICOPTER AND V/STOL AIRCRAFT. VOLUME III, PART I: COMPUTATIONAL METHODS ANALOG
R. A. Castle, A. L. Gray, and Walter Mc Intyre Port Washington, N.Y., Naval Training Device Center, May 1964 152 p refs
(Contract N61339-1205)
(NAVTRADEVCEN-1205-3; AD-607737)

Demonstrated are methods of mechanizing the equations of motion of helicopters and V/STOL aircraft by the use of analog computing equipment. Criteria for the selection of an analog-computer type, such as 60 cycle and 400 cycle, for choice of carrier, and for specific computer components are reviewed. A helicopter and a tilt-wing V/STOL are selected for computer mechanization and for the presentation of computer flow diagrams. Author

N65-11442# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (W. Germany)
REPORT ON ACTIVITIES 1963 [TATIGKEITSBERICHTE 1963]
Peter Bruders, ed. Jul. 1964 133 p refs in GERMAN Available from Vereinigte Universitäts- u. Fachbuchhandlungen, R.-Wagner Str. 1, Cologne, W. Germany

This is a presentation of the organization of the German Research Institute for Aviation and Spaceflight, and of the activities of its various institutes during the year 1963. A general review of the current research projects is presented, and some future work is outlined. G.G.

N65-11500# Lockheed Electronics Co., Plainfield, N.J.
THE CHECKOUT AND MAINTENANCE (CAM) TRAINER. II: DESCRIPTION AND FUNCTIONAL CHARACTERISTICS
Eugene R. Hall, John A. Modrick, Paul R. Richard, and John L. Moss Wright-Patterson AFB, Ohio, AMRL, Jul. 1963 29 p ref
(Contract AF 33(616)-7584)
(AMRL Memo-P-51; AD-602537)

The checkout and maintenance (CAM) trainer is a major device that has been specially constructed for research on electronic maintenance. The device has been designed to support research on problems such as, determining the major sources of difficulty in electronic maintenance, specifying the most efficient techniques and devices for training and aiding electronic maintenance personnel, and developing effective techniques for evaluating the proficiency of personnel performing electronic maintenance. The major components of the CAM trainer are an operational AN/ASB-4 radar system, a student console teaching device for presenting information relevant to the operation of the ASB-4 system, an experimenter's station for recording data and controlling the operation of the student console, and special malfunction generation equipment for inserting controlled malfunctions into the ASB-4 system. This report describes the major components of the CAM trainer, their interrelationships, and their functional characteristics. Schematic diagrams relevant to the trainer are also presented. Author

N65-11564# Goodyear Aerospace Corp., Akron, Ohio
GOODYEAR AEROSPACE TEST FACILITY ARC HEATED WIND TUNNEL Technical Documentary Report, 15 Apr. 1962–15 Oct. 1963
Kenneth A. Young and Joseph J. Meola Wright-Patterson AFB, Ohio, Res. and Technol. Div., Oct. 1963 58 p refs
(Contract AF 33(616)-7599)
(RTD-TDR-63-4090; AD-607972)

This hyperthermal test facility is a nonrecirculating arc tunnel with a continuous steam-ejector evacuation system. The 1.8-megawatt input power is supplied by three diesel-electric locomotives. The arc or plasma generator utilizes water-cooled concentric copper electrodes with magnetic spin stabilization. The arc operation time, arc head component life, and diesel power utilization are summarized. Test procedures and operation of the arc tunnel are described. Development and modifications to the facility are discussed. Author

N65-11653# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON MOTION OF A SHOCK WAVE DURING NONINSTANTANEOUS OPENING OF DIAPHRAGM IN SHOCK TUBE
V. T. Kireev *In its* Mechanics and Mech. Eng. 7 Jan. 1964 p 15–20 refs (See N65-11651 02-12)

It has been shown that the increase in speed of a shock wave in the initial zone of its motion in a shock tube is caused by the noninstantaneous opening of the diaphragm. A flow model is presented that allows the determination of the change of speed of the shock wave and of the flow parameters of gases pushing and being pushed during the opening of the diaphragm. From the results of an example of calculation for a shock tube with square cross section, it is concluded that the time of opening of the diaphragm depends little on resisting forces; because of the brevity of the process, inertial forces will be the determining factors. D.S.G.

N65-11669# Aerospace Research Labs., Wright-Patterson AFB, Ohio
A BRIEF SYNOPSIS OF IN-HOUSE RESEARCH
D. C. Reynolds et al Sep. 1964 25 p refs
(ARL-64-159; AD-604007) OTS: $0.75

The current studies in solid-state physics, plasma physics, and general physics are presented. Also discussed is research in chemistry, metallurgy and ceramics, applied mathematics, hypersonic studies, fluid dynamics, and thermomechanics. G.G.

N65-11715# Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
William M. Leak, ed. Sep. 1964 52 p refs
(AD-606809) OTS: $1.25

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N65-11716# Naval Research Lab., Washington, D.C. Reactor Materials Branch
THE NRL HIGH LEVEL RADIATION LABORATORY
H. E. Watson and L. E. Steele *In its* Rept. of NRL Progr. Sep. 1964 p 1–10 (See N65-11715 02-11) OTS: $1.25

The growing use of nuclear energy for propulsion and power has accelerated the need for developing solutions to problems of nuclear radiation damage to reactor structural materials. In recognition of these problems and the need for comprehensive evaluation of the properties of materials that have been exposed to high-energy nuclear radiation, the NRL High Level Radiation Laboratory was constructed. This laboratory provides a versatile facility for the study of highly radioactive materials. Sources of gamma radiation as great as 500 000 curies (E = 1 MeV) can be safely handled in radiation cells of the new laboratory. Author

N65-11888# Naval Civil Engineering Lab., Port Hueneme, Calif.
RECENT APPLICATIONS OF RADIOISOTOPES
Leonard B. Gardner 24 Aug. 1964 12 p refs
(TN-N-606; AD-606253)

Of the possible radioisotope applications to practical problems, the two that appear most promising are the determination of soil density and moisture content and the determination of snow-pack thickness. The most promising of the research applications of radioisotopes are evaluation of paints, brine migration, and the detection of scale formation. Author

N65-11960# Naval Ordnance Test Station, China Lake, Calif.
PERSONNEL SHIELDING First Progress Report
Paul A. Donaldson Sep. 1963 19 p refs *Its* Tech. Progress Rept.-326
(NOTS-TP-3287; AD-423665)

This report assembles and summarizes the results of tests performed on safety glass and plastic shields designed to protect personnel from the effects of detonation or explosion. Variables to be investigated in future testing are discussed. Author

N65-11963# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Flight Dynamics Lab.
THE DESIGN OF A DIFFUSER AND HEAT EXCHANGER FOR A FOUR MEGAWATT ELECTROGASDYNAMIC TEST FACILITY
James T. Van Kuren Sep. 1964 31 p refs
(FDL-TDR-64-93; AD-608047)

The design of a diffuser and heat exchanger for a hypersonic aerodynamic test facility is presented in detail. Convective heat flux from 9000° F air to the diffuser wall and heat exchanger tubes is analyzed. Thermal and mechanical stresses are predicted as part of a complete design. Auxiliary equipment required to give a complete cooling system is described. Author

N65-11976# Boeing Co., Seattle, Wash.
SPECIFICATION, X-20 (MARK II-A) SIMULATOR CREW STATION AND REPEATER CONSOLE
E. P. Goodrich [1963] 42 p
(Contract AF 33(657)-7132)
(D2-80797; AD-444156)

Defined are the crew station, repeater console, and interconnecting cables for the Mark IIA simulator, to be interconnected with computers, power supplies, and other equipment, for mission planning and crew training in the X-20 glider flight-test program. R.L.K.

N65-12010# Battelle Memorial Inst., Columbus, Ohio Radiation Effects Information Center
SURVEY OF PARTICLE ACCELERATORS, PART II
Donald J. Hamman and Walter H. Veazie, Jr. 15 Sep. 1964 218 p
(Contract AF 33(615)-1124)
(REIC-31, Pt. II; AD-420200)

The report presents data sheets on betatrons, fixed-frequency cyclotrons, frequency-modulated cyclotrons, variable-frequency cyclotrons, linear accelerators, potential-drop machines, and synchrotrons. Author

N65-12022*# Northrop Space Labs., Huntsville, Ala.
APOLLO LOGISTICS SUPPORT SYSTEMS MOLAB STUDIES. TASK REPORT ON MOLAB CONCEPT EVALUATION METHOD, 8 JUNE–21 AUGUST 1964
D. Ross Huntsville, Ala., NASA. Marshall Space Flight Center [1964] 47 p
(Contract NAS8-11096)
(NASA-CR-61021) OTS Prices: HC $2.00/MF $0.50

An attempt to establish a model with which various design concepts of the Manned Lunar Surface Mobile Laboratory Vehicle (MOLAB) can be technically evaluated is discussed. The concept parameters considered were crew safety, reliability, design simplicity, lunar terrain negotiability, performance efficiency, weight, development risk, and cost. The parameters were considered for the stowage, deployment, dormant, and operational phases of the mission. A matrix of approximately 500 technical items was assembled for the evaluation of the various systems. The matrix endeavors to cover some of the major technical parameters of each system. The matrix is presented, along with the method of grading, and represents a system that will accomplish a general evaluation of the MOLAB and its systems. P.V.E.

N65-12051# Alabama U. Research Inst., Huntsville
AN EVALUATION OF THE DESIGN, AND A THEORETICAL STUDY OF THE SIMULATION CAPABILITY OF AN EIGHT-MEGAWATT ARC-HEATED HYPERSONIC WIND TUNNEL FACILITY Final Technical Report

Edgar R. F. Winter, Janardanaro Yalamanchili, and Joseph C. Dowdle Mar. 1964 143 p refs
(Contract DA-01-009-AMC-18(Z))
(UARI-15; AD-444505)

The capabilities and limitations of an arc-heated blowdown wind tunnel to simulate flow parameters of a reentering ICBM are investigated theoretically. The expected efficiency, control, and response time of the rotary power supply are presented. The meaning of temperature is discussed. Calculated nonequilibrium nozzle flow parameters are presented graphically. The calculation procedure for real-gas equilibrium inviscid flow around a pointed cone is given. Author

N65-12075# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
A VACUUM EVAPORATOR FOR AN INVESTIGATION OF THE MAGNETO-OPTIC PROPERTIES OF INTERMETALLIC COMPOUND FILMS Technical Documentary Report, Mar. 1962–Oct. 1963
Axel M. Stoffel and Karl J. Strnat Jun. 1964 25 p refs
(ML-TDR-64-130; AD-605378)

This report describes an ultrahigh-vacuum evaporator that is part of an apparatus for use in an investigation of the magneto-optical properties of ferromagnetic intermetallic compounds in thin-film form. Samples can be prepared by vapor deposition from two sources and subsequent annealing in vacua of approximately 10^{-9} torr. A torque magnetometer built into the system can be used for magnetization measurements, and an external ellipsometer allows determination of magneto-optical constants on the films without removing them from the high vacuum in which they were prepared. Author

N65-12086*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SPECTROGRAPHIC ANALYSIS OF A 1-FOOT HYPERSONIC-ARC-TUNNEL AIRSTREAM USING AN ELECTRON BEAM PROBE
Daniel I. Sebacher and Roy J. Duckett Washington, NASA, Dec. 1964 20 p refs
(NASA-TR-R-214) OTS Prices: HC $0.50/MF $0.50

An electron-beam apparatus that permits measurements of free-stream vibrational and rotational temperatures and of density by spectrographic analysis is discussed, and results of the experiment are presented. The beam was used to probe the free stream of an arc-heated hypersonic wind tunnel with a 1.5-mw power supply. At a tunnel stagnation chamber temperature of about 3700° K and a pressure of 22 atm the test-section Mach number was about 12. By using the electron beam to probe this airflow it was found that the nitrogen molecules were in rotational equilibrium (rotational temperature of 155° K) but in vibrational nonequilibrium (vibrational temperature of approximately 1600° K). The equilibrium free-stream temperature was calculated to be 143° K. Author

N65-12091# Air Proving Ground Center, Eglin AFB, Fla.
MANNED SPACE FLIGHT NETWORK STATION 17, EGLIN AFB, SUPPORT FOR THE SATURN, SA-5, MISSION Technical Documentary Report, 29 Jan.–1 Apr. 1964
Ronald L. De Cosmo and Richard E. Williamson Aug. 1964 31 p
(APGC-TDR-64-57; AD-447891)

The fifth Saturn I vehicle successfully placed a 19-ton payload into a nominal orbit having an estimated life of at least 600 days. This report describes the Station 17 support for the fifth mission. The general mission objectives, actual mission profiles, support facilities, and skin tracking results are presented. Special emphasis is placed on the skin tracking and acquisition techniques developed by Station 17. Author

N65-12130# General Dynamics/Fort Worth, Tex.
INVESTIGATION OF MEASUREMENT ERRORS OF THE RAT SCAT CROSS SECTION FACILITY
C. C. Freeny, T. R. Leeth, J. W. Jones, and M. F. Brust Griffiss AFB, Ohio, RADC, Jul. 1964 117 p refs
(Contract AF 30(602)-2831)
(RADC-TDR-64-397; FZE-222-7; AD-608429)

Investigations were limited to monostatic cross-section measurements using the principle polarizations, horizontal and vertical, and frequencies in the range 1 to 10 Gc. A model for the field over the target region involving antenna height, antenna size, target height, frequency, and distance to the target is presented, along with appropriate measured data. These models are in most cases standard first-order approximations used in estimating fields on a ground plane range. Major potential errors are classified into four categories for which investigations were conducted. The test programs and results are presented for each of the four types of errors investigated, as well as for the ground plane model. Author

N65-12156# Naval Air Development Center, Johnsville, Pa. Aeronautical Electronic and Electrical Lab.
HIGH-CURRENT (SHORT-CIRCUIT) FACILITIES FOR AIRCRAFT CONTROL AND PROTECTIVE DEVICES
J. Triolo 15 Sep. 1964 33 p Presented at the Bur. of Naval Weapons Symp. on Advanced Tech. for Aircraft Elec. Systems, Washington, D.C., 13–14 Oct. 1964
(NADC-EL-6451; AD-448457)

This presentation describes the ac and dc high-current facilities at the U.S. Naval Air Development Center for overload and rupture testing of aircraft control and protective devices. The procedures and conditions under which government and industrial activities may use these facilities are outlined. Author

N65-12162# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Flight Dynamics Lab.
A 50-MEGAWATT ARC HEATER: SCALING PARAMETERS AND PERFORMANCE PREDICTION
Richard T. Smith and Joseph P. Doyle Aug. 1964 62 p refs
(FDL-TDR-64-91; AD-607710)

The facility is a continuous flow, electric arc heated, hypersonic wind tunnel for reentry heat transfer and aerodynamic testing in air. A brief description of arc wind tunnel work is presented. Arc heater test data up to 5 megawatts of power are presented, and problems associated with high-pressure operation of these high-voltage heaters are discussed. The 50-megawatt arc heater design is discussed, along with the expected performance of the heater and facility. Author

N65-12308*# Hayes International Corp., Birmingham, Ala. Missile and Space Support Div.
APOLLO LOGISTICS SUPPORT SYSTEMS MOLAB STUDIES: TASK REPORT ON NAVIGATION SYSTEM STUDIES (PRELIMINARY), JUL. 20–SEP. 1964
B. A. Perkins Oct. 1964 91 p refs
(Contract NAS8-5307)
(NASA-CR-61022) OTS Prices: HC $3.00/MF $0.75

This report is concerned with state-of-the-art hardware that may be used to meet navigational requirements for a Lunar Mobile Laboratory (MOLAB). Discussed are ways of obtaining heading and vertical orientation by combined vertical and directional gyros, radio-frequency navigation equipment, celestial navigation hardware, optical ranging, and LEM–MOLAB relative navigation. R.L.K.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-10965# Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
PRESSURE GRADIENT EFFECTS OF EQUILIBRIUM LAMINAR AND TURBULENT FAR WAKES
N. Ness and J. B. Fanucci Jul. 1964 52 p refs
(Contract DA-01-021-AMC-10963(Z); ARPA Order 51; Proj. Defender)
(RATM-64-01; AD-447415)

Pressure-gradient effects on equilibrium far-wake flow properties are evaluated. Transition to turbulence is included in the analysis. Calculations are performed for two cases. In one case the pressure is constant at its ambient value, and in the second case the pressure distribution (assumed to be that given by blast wave theory) decreases rapidly in the downstream direction to its ambient value. Comparison with the nonequilibrium chemistry analysis is included. One distinguishing feature of the present program is the direct calculation of the equilibrium state of the gas, thereby precluding the need for curve fitting the standard air Mollier charts. The results show that the pressure gradient has a minor effect on centerline electron number density, on centerline velocity, and on centerline temperature when equilibrium chemistry is imposed. However, pressure gradient foes have a significant effect on wake thickness. Author

N65-11006# Michigan U., Ann Arbor Heat Transfer Lab.
A REVIEW OF PRESSURIZATION, STRATIFICATION AND INTERFACIAL PHENOMENA
John A. Clark [1964] 74 p refs Presented at the Cryog. Eng. Conf., Philadelphia, 1964

This paper is a survey of the available literature on the pressurization processes and the associated effects of stratification in both liquid and gas. Important interfacial phenomena of heat and mass transfer have been the subject of a great deal of research effort, and most of this has been directly related to the performance of the propellant tanks on large rocket vehicles. Author

N65-11031# Cornell U., Ithaca, N.Y. Lab. of Atomic and Nuclear Physics
PHOTOIONIZATION OF THE 4d ELECTRONS IN XENON
D. L. Ederer Sep. 1964 27 p refs
(Contract Nonr-401(37))
(TR-11; AD-605569)

The photoionization of the 4d electron in xenon was observed in a cross section, and the discrete 4d to np transition was studied quantitatively. A striking similarity between the tellurium cross section of practically zero and its peak of approximately 40 eV above threshold and that of the xenon cross section of almost zero and its rise to about 30 eV was observed. The characteristics of the photoabsorption by 4d electrons, as typified by xenon and tellurium, are quite singular even in the solid state. It was found that the xenon cross section at threshold is of the order of a few mb, and it rises almost linearly from the threshold to a broad maximum of approximately 28 mb 2.2 Ry above threshold, but falls rapidly at energies greater than 2.2 Ry. There seems to be an interaction between the 4p and 4d electrons that suppresses the absorption of 4p electrons near threshold of about 150 eV. G.G.

N65-11036# New York U., N.Y. Magneto-Fluid Dynamics Div.
ASYMPTOTIC EQUIVALENCE OF THE NAVIER-STOKES AND NONLINEAR BOLTZMANN EQUATIONS
Harold Grad 30 Sep. 1964 56 p refs Submitted for Publication
(Contract AF(30-1)-1480)
(NYO-1480-7; MF-41)

Previous theory of the linear Boltzmann equation is extended to somewhat nonlinear problems. For sufficiently small initial data, solutions are shown to exist for macroscopically long times. If the mean free path is small, the nonlinear solution is particularly well approximated by the linear solution, and it is also approximated by the macroscopic Navier–Stokes solution of an equivalent problem. Author

N65-11037# New York U., N.Y. Magneto-Fluid Dynamics Div.
ACCURACY AND LIMITS OF APPLICABILITY OF SOLUTIONS OF EQUATIONS OF TRANSPORT; DILUTE MONATOMIC GASES
Harold Grad 30 Sep. 1964 25 p refs A Chapter from Proc. of the Intern. Seminar on the Transport Properties of Gases, Brown Univ., 20–24 Jan. 1964
(Contract AT(30-1)-1480)
(NYO-1480-8; MF-42)

The theory of the Boltzmann equation for a simple gas of monatomic molecules is presented, and several analytical problems using this method are discussed. A strict expansion of eigenfunctions is used in the linear, as well as the nonlinear, problems, and in integral iteration techniques. It is concluded that the problems that appear to be solvable by these techniques, using the Boltzmann equation, are far from being exhausted. G.G.

N65-11044# Mithras, Inc., Cambridge, Mass.
COMPRESSIBILITY EFFECTS ON FLUID ENTRAINMENT BY TURBULENT MIXING LAYERS
Jacques A. F. Hill and James E. Nicholson Washington, NASA, Nov. 1964 57 p refs
(Contract NASw-601)
(NASA-CR-131) OTS Prices: HC $1.50/MF $0.50

Fluid entrainment by supersonic turbulent mixing layers was measured on a wind-tunnel model over a wide range of Mach numbers and ratios of the densities of the moving and stationary fluids. The wind-tunnel model consisted of a forward-facing spike on a flat-faced cylinder. In the supersonic airstream this geometry generated a conical region of separated flow bounded by a constant-pressure mixing layer. By detecting whether or not there was any recirculation at the reattachment line, it was possible to supply fluid to the separated region at the same rate at which it was entrained by the mixing layer. The entrainment coefficient of the mixing layer could thus be calculated by metering the fluid supplied. Author

N65-11083# RAND Corp., Santa Monica, Calif.
THE EFFECT OF SURFACE-EVAPORATION KINETICS ON THE SUBLIMATION INTO A BOUNDARY LAYER
A. F. Charwat Jun. 1964 42 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3291-PR; AD-601328)

The behavior of the laminar binary boundary layer with blowing is coupled with the kinetic-evaporation-rate law of the surface material. The solution of this combined problem exhibits an asymptotic behavior at large Reynolds number that is identified with the usual near-equilibrium solution in which the vapor near the wall is very nearly in thermodynamic phase-change equilibrium. However, the near-equilibrium solution is

invalid in a region near the origin of the boundary layer, which is characterized by a length formed with physical parameters describing the basic flow and the surface properties. In this region, which is treated approximately, the blowing parameter decreases to zero, the wall temperature increases, and the sublimation rate tends to an upper limit as the origin of the boundary layer is approached. The principal result of the analysis is the estimation of the length of the region of transition to the near-equilibrium solution. Author

N65-11090# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
GENERAL METHOD FOR SOLVING NONEQUILIBRIUM LAMINAR-BOUNDARY-LAYER FLOW OF A BINARY GAS
Darwin W. Clutter, A. M. O. Smith, and N. A. Jaffe 15 Oct. 1964 136 p refs
(Contract NOw-60-0533-c)
(LB-31616; AD-607733)

The purpose of the present project is the development of an accurate method for solving the complete equations of dissociated laminar-boundary layer flow of a binary gas in chemical nonequilibrium. The primary concern is the mathematical solution rather than the physics and chemistry of the flow processes. Boundary conditions, both at the edge of the boundary layer and at the wall are completely arbitrary. The only restriction on the method is that the flow be either axially symmetric or two-dimensional. The second-order terms of transverse curvature are approximately accounted for. The method of solution consists of replacing the partial derivatives with respect to the flow direction by finite differences, while retaining the derivatives in a direction normal to the boundary, so that the partial differential equations become approximated by ordinary differential equations. The ordinary differential equations are solved simultaneously at a given station in the flow direction as the calculation proceeds downstream. Author

N65-11130# Massachusetts Inst. of Tech., Cambridge
MOLECULAR BEAM-SURFACE INTERACTIONS Final Report
[1964] 16 p
(Grant AF-AFOSR-131-63)
(AFOSR-64-1661; AD-606078)

The velocity distribution of helium and water vapor, based on the time-of-flight principle, was investigated by a molecular velocity spectrometer. A hypodermic tube was used to provide a direct beam of molecules in a high-vacuum chamber. The gained oscilloscope tracing data were compared to the analytical data for a beam of the Maxwellian distribution of velocities, and considerable deviation was found. To overcome the considerable difficulty of separating signal from noise at low beam intensity, the design and development of a new signal discriminator were undertaken. G.G.

N65-11158# General Electric Co., Santa Barbara, Calif.
AXIAL-SYMMETRIC BLAST WAVES IN FLUID DYNAMICS AND MOTION OF PARTICLES
Guenter M. Schindler 15 Apr. 1964 106 p refs
(Contract DA-49-146-XZ-190)
(DASA-1507; RM-64-TMP-17; AD-605201)

The present report deals with the solution of axial-symmetric shock waves in fluid dynamics generated by a point source explosion, and with the determination of the particle paths. The entire blast wave problem is formulated as a classical initial-boundary value problem; some approaches to its numerical solution are elaborated. Special attention is paid to the uniqueness of the solutions, and to the possibility of determining geometric configuration and expansion rate of the shock wave without integrating the fluid dynamics equations. The effectiveness of the method developed is demonstrated in an application to a particular situation. Author

N65-11189# Southampton U. (Gt. Brit.)
PROPERTIES OF THE FLUCTUATING WALL-PRESSURE FIELD OF A TURBULENT BOUNDARY LAYER
M. K. Bull Mar. 1963 46 p refs
(AASU-234)

The paper presents results of measurements of the root mean square, frequency power spectrum, and space–time correlations of the fluctuating wall pressure field associated with a turbulent boundary layer. Correlation measurements in broad and narrow frequency bands indicate that the small-scale components of the wall pressure field are convected slowly and rapidly lose coherence, and that in the main they arise from turbulent motion in the inner regions of the boundary layer. On the other hand the large scale components of the field are convected rapidly, lose coherence slowly, and arise from sources fairly widely distributed throughout the layer. Correlations between wall pressure fluctuations and the longitudinal component of velocity fluctuation indicate that the inner regions of the boundary layer make the greatest contribution to the wall pressure. Author

N65-11221# RAND Corp., Santa Monica, Calif.
A DIFFERENCE APPROXIMATION FOR THE MOMENTUM EQUATION OF A TWO-DIMENSIONAL, CYLINDRICALLY SYMMETRIC, SHOCK HYDRODYNAMICS PROGRAM
Richard Grote and Sherman Gratch Sep. 1964 19 p ref
(Contract AF 49(638)-700; Proj. RAND)
(RM-4233-PR; AD-605315) OTS: $1.00

A finite-difference approximation for the momentum equation of a two-dimensional Lagrangian shock hydrodynamics computer program with cylindrical symmetry is developed from Euler's equation for an inviscid fluid. Author

N65-11234# Argonne National Lab., Ill. Chemical Engineering Div.
THE EFFECT OF PARTICLE SIZE ON THE PROPERTIES OF GAS-FLUIDIZED BEDS
K. S. Sutherland (Atomic Energy Res. Estab., Gt. Brit.) Jul. 1964 56 p refs
(Contract W-31-109-ENG-38)
(ANL-6907)

The development of a continuous method for determining changes in particle size and particle-size distribution in fluid-bed systems has been studied experimentally. Differential pressure measurements were employed to study the effects of solid-particle size on the behavior of gas-fluidized beds. The relevant bed properties are briefly described, and a review is given of previous work on the study of fluidized-bed quality. It is shown that, within certain limitations, measurements of bed quality can be used to indicate changes in particle size. Gas-bubble velocities, while increasing in proportion to the square root of bubble diameter, are also shown to be dependent on particle size, increasing as the particle size decreases. Author

N65-11254# General Electric Co., Philadelphia, Pa. Missile and Space Div.
IONIZATION OF CESIUM AND SODIUM CONTAMINATED AIR IN THE HYPERSONIC SLENDER BODY BOUNDARY LAYER
M. Lenard Aug. 1964 33 p refs
(R64SD22)

An approximate procedure is used to predict the effect on air ionization of small amounts of cesium and sodium in the ablating surface material of pointed cones. Ionization is assumed to occur due to finite-rate gas-phase chemical reactions in the laminar boundary layer. An 11 species (N_2, O_2, N, O, NO, Cs or Na, NO^+, Cs^+ or Na^+, O_2^-, O^-, e^-), 16 reaction chemical system is assumed. Author

N65-11257# Texas U., Austin Hydraulic Engineering Lab.
DRAG FORCES IN VELOCITY GRADIENT FIELDS
Charles Dalton and Frank D. Masch Mar. 1964 47 p refs
(Contract Nonr-375(16))
(HYD-04-6401; AD-603778)

This report presents work completed to date on an investigation of drag forces on cylinders in linear velocity gradient fields. Theoretical consideration has been given to the flow field that develops at the cylinder under the influence of the gradient. Limited experimental data have been processed that show the local drag coefficient is low in regions where the velocity is high and is high where the velocity is low. Average drag coefficients have been found to be greater than the conventional value of 1.2 at low cylinder length to diameter ratios in the Reynolds number range of 10^4 to 10^5. Author

N65-11304*# Consultants and Designers, Inc., Arlington, Va.
EXACT SOLUTION OF THE PROBLEM OF SUPERSONIC GAS FLOW PAST CERTAIN SPATIAL BODIES [TOCHNOYE RESHENIYE ZADACHI OBTEKANIYA NEKOTORYKH PROSTRANSTVENNYKH TEL SVERKHZVUKOVYM POTOKOM GAZA]
A. L. Gonor 13 Nov. 1964 7 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 28, no. 5, 1964 p 974–976
(Contract NAS5-3760)
(NASA-TT-F-8991; ST-AD-10240) OTS Prices: HC $1.00/MF $0.50

The exact solution for spatial bodies of a starlike structure is analyzed. Considered is a system of plane intersecting discontinuities passing through the origin of the coordinates. The velocity of the incident flow and the Mach number are used in the formation of the equations. It was found that the drag of a star-shaped body will decrease when the number of the ribs is increased and all other parameters remain stable. G.G.

N65-11309*# National Aeronautics and Space Administration, Washington, D.C.
A STUDY OF SUPERSONIC EXPLOSIONS [ETUDES DES DETONATIONS SUPERSONIQUES]
Pierre Lienard Nov. 1964 15 p refs Transl. into ENGLISH of a paper presented at the 3rd Intern. Cong. on the Struggle against Noise, 13–15 May 1964
(NASA-TT-F-9167) OTS Prices: HC $1.00/MF $0.50

The purpose of the study is to determine a method for predicting supersonic explosions, and to calculate trajectories for which a given pressure amplitude will not be exceeded on the ground. A cathodic oscillograph, membrane-pressure receivers, and mutual-inductance receivers are used in the study. Author

N65-11310*# National Aeronautics and Space Administration, Washington, D.C.
SOME CONSIDERATIONS ON TWO-PHASE FLUID HYDRAULICS [QUELQUES CONSIDERATIONS SUR L'HYDRAULIQUE DES FLUIDES BIPHASES]
Mario Silvestri (C.I.S.E.,Milan) Nov. 1964 16 p Transl. into ENGLISH of a paper Presented at 7th Journees de l'hydraulique, Paris, Jun. 1962 p 111–117
(NASA-TT-F-9168) OTS Prices: HC $1.00/MF $0.50

Two-phase fluids present more than a dozen types of outflow, in contrast to monophase fluids for which there are only two—laminar and turbulent. Interest has centered on dispersed annular outflow, which can be defined as outflow characterized by high linear velocity and by a liquid phase distribution in the form of droplets in the gaseous phase, with a very thin layer adhering to the walls of the outflow channel. Conclusions have been deduced from an examination of the experimental results concerning the thickness of the liquid film as a function of different physical variables coming into play (dynamic variables and physical properties of the two phases in motion) and the distribution of the liquid phase in the center of the canal. Author

N65-11360# Massachusetts Inst. of Tech., Cambridge Engineering Projects Lab.
AN INTRODUCTION TO TWO-PHASE GAS-LIQUID FLOW
S. William Gouse, Jr. Jun. 1964 131 p refs
(Contract Nonr-1841(73))
(DSR-8734-3; AD-603659) OTS: $5.00

Various aspects of the two-phase gas–liquid flow have been investigated in order to uncover the differences between single and multiphase flow, and to point out some distinctions between various kinds of two-phase flows. The following topics are presented: "Equations of Change in Integral and in Differential Form"; "Analytical Models for Conservation of Momentum and Energy"; "Two-Dimensional Homogeneous Two-Phase One-Component Flow"; "Martinelli Et Al Two-Phase Flow Model"; "Momentum Exchange Model"; "Separated Phase Analytical Model"; and "Other Approaches." G.G.

N65-11371# Washington U., Seattle Coll. of Engineering
AN EXPERIMENT ON TURBULENT FLOW IN A PIPE WITH A FLEXIBLE WALL
Larry Lacross Smith (M.S. Thesis) 1963 46 p refs
(AD-294721)

A test section was made by casting a highly pliant, elastic gel between two concentric pipes. The inner pipe was then removed leaving a flexible boundary for flow studies. Fluid was made to flow through the test section, and pressure drop measurements were recorded at Reynolds numbers ranging from 1800 to 15 200. The pressure drop across the flexible boundary was found to be greater than that encountered in a similar section with a solid boundary. Below Re 13 500, this increase can be explained either in terms of effective wall roughness or by an effect of the flexible boundary on turbulence. Above Re 13 500, the data indicate a pressure-drop increase due to the effects of the flexible boundary. Author

N65-11382# Boeing Co., Seattle, Wash.
COMPARISON OF EXPERIMENTAL BOUNDARY LAYER PROFILES AND THOSE PREDICTED BY THE DISSOCIATED TURBULENT FLAT PLATE SKIN FRICTION PROGRAM
M. B. Donovan [1963] 42 p refs
(D2-22093; AD-444674)

This document presents further results obtained from the turbulent dissociated flat-plate skin-friction program. Velocity and temperature profiles computed by the program are compared with experimental profiles. Since available data are limited to undissociated flow and Mach numbers

less than 10, comparisons are limited to these flow conditions. For the range of theoretical cases considered, a 1/10 power law is found to be a good approximation to the velocity profiles. Author

N65-11402*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

COMPARISONS OF EXPERIMENTAL WITH PREDICTED WALL STATIC-PRESSURE DISTRIBUTIONS IN CONICAL SUPERSONIC NOZZLES

L. H. Back, P. F. Massier, and H. L. Gier 15 Oct. 1964 23 p refs

(Contract NAS7-100)

(NASA-CR-59577; JPL-TR-32-654) OTS Prices: HC $1.00/MF $0.50

Wall static pressures have been measured at stagnation pressures between 45 and 250 psia in circular-arc-throat conical nozzles with half-angles of convergence of 30° and 45°, 15° half-angles of divergence, and expansion-area ratios to 6.6. In several additional nozzles, the convergent section was formed by circular arcs. The ratios of throat radius of curvature to throat radius, r_c/r_{th}, were 2.0 and 0.625. These measurements made with air either at a stagnation temperature of 530° R or heated by the combustion of methanol to 1500° R, indicate considerable deviations from one-dimensional isentropic flow predictions in the throat region. For one nozzle, these amount to as much as 45%. Deviations of a smaller magnitude are also found in the conical sections. The static-pressure measurements for underexpanded operation were sensitive both to the effects of cooled and uncooled walls and to variations in nozzle-inlet boundary-layer thickness. Author

N65-11406*# New Hampshire U., Durham

CONSERVATION OF THE FIRST AND SECOND ADIABATIC INVARIANTS

Richard L. Kaufmann Sep. 1964 24 p refs

(Grant NsG-624)

(NASA-CR-59566) OTS Prices: HC $1.00/MF $0.50

Changes expected in the energy and equatorial pitch angles of geomagnetically trapped particles are calculated, assuming the first and second adiabatic invariants are conserved and the third invariant is violated. Sample calculations are compared to experimental results, and it is concluded that this mechanism may be of importance in producing the observed distribution of 1 MeV electrons, but cannot be coupled with the polar cap neutron albedo source to explain the observed distribution of 1 MeV to 100 MeV protons. The figures presented aid in distinguishing changes produced by the violation of the third invariant from changes produced by violation of the first and second invariants. Author

N65-11418# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

STRUCTURES IN AN ARCTIC ENVIRONMENT. AIRBLAST AND SUBSURFACE SHOCK OF HIGH-EXPLOSIVE TESTS Report No. 3

C. E. Joachim Oct. 1964 78 p refs *Its* Tech. Rept.-1-649 (AD-450624)

Two 4180-, one 1860-, and one 500-lb C-4 charges; two 36-lb C-3 charges, and nine 256-lb TNT charges were detonated on or near the snow surface in the vicinity of Camp Century on the Greenland Ice Cap. Airblast pressure–time measurements were made to determine pressure loading on the snow surface, and acceleration-time measurements were made to determine motion near the snow surface. Results indicate that significant differences are obtained when cube-root scaling is used for airblast predictions for shock waves generated and traveling over deep snow. The acceleration records showed a strong, late-arriving, secondary pulse which was first thought to be caused by a ground wave moving toward the burst point (regressive motion). However, when particle velocity and displacement histories were obtained by successive integration of the records, it was evident that the phenomenon was caused by gross motion of the snow near the surface. Author

N65-11420# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

FLOW OF AIR INTO A PARTIALLY-CASED SNOW TRENCH

Yin-Chai Yen and Don Fisher Aug. 1964 17 p refs

(CRREL-RR-144; AD-449420)

For isothermal, steady, two-dimensional flow with constant permeability, an expression was derived for the quantity of air flowing into a partially cased, rectangular snow trench. The formula, which is readily evaluated for any flow geometry, is

$$Q = \frac{K'}{2K}\left(\frac{k}{\mu}\right)(\rho_{avg})\ (p_s - p_w)$$

where Q is the mass flow rate; K'/2K is a configuration factor related to the depth of the trench d_t, the depth of the casing d_c, and the depth to the impermeable layer d_l; k is permeability and μ is viscosity of air; ρ_{avg} is the average air density calculated at mean pressure $P_s + P_w/2$; and p_s and p_w are the air pressures at the snow surface and the uncased trench walls, respectively. Author

N65-11430# ARO, Inc., Arnold Air Force Station, Tenn. Scientific Computing Branch

A TECHNIQUE FOR SOLVING INTEGRO-DIFFERENTIAL EQUATIONS WITH APPLICATION TO TURBULENT MIXING

W. J. Phares and F. C. Loper Arnold Eng. Develop. Center, Nov. 1964 24 p refs

(Contract AF 40(600)-1000)

(AEDC-TDR-64-209; AD-450730)

As part of an investigation of variable area mixing of coaxial streams with afterburning, a mathematical technique was developed for the theory of turbulent mixing. This report is primarily concerned with the mathematical method employed to convert the nonlinear conservation equations to a form that is amenable to conventional numerical techniques. Author

N65-11440# Illinois U. Urbana Engineering Experiment Station

RESEARCH ON TRANSONIC AND SUPERSONIC FLOW OF A REAL FLUID AT ABRUPT INCREASES IN CROSS SECTION (WITH SPECIAL CONSIDERATION OF BASE DRAG PROBLEMS) Final Report

H. H. Korst, W. L. Chow, and G. W. Zumwalt Oct. 1964 158 p refs

(Contract AF 18(600)-392)

(ME-TN-392-5, 2d ed.; OSR-TR-60-74; AD-239139)

A general theory for pressures and temperatures in separated transonic and supersonic flows is developed, using a physically perceptive model composed of simplified flow components. The principle of interaction between dissipative and free-stream flow regions allows a distinction between inviscid flow configurations and superimposed jet-mixing regions. A great variety of problems in both internal and external flow are analyzed theoretically, ranging from the classical base-pressure problem to the performance of supersonic ejectors and the detailed study of the jet–slipstream interaction (afterbody) problem in jet engine and rocket propulsion. The status of the problem of separated flow presented is essentially that of the completion date of the first edition, December 1959, but continued requests have necessitated the publication of this second edition. M.P.G.

N65-11448*# Consultants and Designers, Inc., Arlington, Va.
PASSAGE THROUGH THE SPEED OF SOUND IN LAVAL NOZZLES WITH CIRCULAR CROSS SECTION [O PEREKHODE CHEREZ SKOROST' ZVUKA V SOPLAKH LAVALYA S KRUGLYM POPERECHNYM SECHENIYEM]
Yu. B. Lifshits and O. S. Ryzhov 6 Nov. 1964 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Aerodinam. (USSR), v. 158, 1964 p 562–565
(Contract NAS5-3760)
(NASA-TT-F-8988; ST-AD-10239) OTS Prices: HC $1.00/MF $0.50

The Karman equations describing the axisymmetric transonic flow were applied in a study of the peculiarities of the passage through the speed of sound in Laval nozzles with circular cross sections. It was observed that the formation of shock waves near the critical cross section of the nozzle is linked with an over-prolonged transitional part. The increase of distance between the nozzle neck and the intake of the channel leads to a slower expansion of the flow and to the appearance of discontinuities. Thus, the transitional part in the nozzle construction should be kept as short as possible. G.G.

N65-11449*# Consultants and Designers, Inc., Arlington, Va.
ON THE EFFECT OF SOLAR ACTIVITY ON PROCESSES IN THE EARTH'S LOWER ATMOSPHERE [O VLIYANII SOLNECHNOY AKTIVNOSTI NA PROTSESSY B NIZHNEY ATMOSFERE ZEMLI]
M. N. Gnevyshev and B. I. Sazonov 20 Nov. 1964 9 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 41, no. 5, 1964 p 937–941
(Contract NAS5-3760)
(NASA-TT-F-8996; ST-SP-AM-10245) OTS Prices: HC $1.00/MF $0.50

Analysis of baric maps (altitude higher than 5000 meters) of the Northern Hemisphere for the years 1949 to 1962 has shown that the areas of greater recurrence of maximum and minimum pressure at upper troposphere and lower stratosphere heights are concentrated in the annular zones, similar to those of auroras. A number of these baric formations have two maxima in the 11-year cycle, coinciding with the corresponding maxima in the glow intensity of the coronal line λ 5303 Å. Therefore, both the geographical distribution of altitude baric formations and their variations in time suggest that they are determined by solar corpuscular radiation. Author

N65-11468# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MODELING CIRCULATORY FLOWS BY THE METHOD OF ELECTROHYDRODYNAMIC ANALOGY WITH APPLICATION OF A VORTEX ELECTRIC FIELD
G. A. Ryazanov 12 May 1964 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 3, 1961 p 68–77
(FTD-MT-63-213; AD-606413)

The analogy between the vortex electric field in a conducting medium and the circulatory flow of an ideal liquid is considered, and a new method of modeling of three-dimensional circulatory flows, based on the application of toroidal transformers, is offered. Installations for the solution of two-dimensional and axially symmetric problems are described, and the data of control experiments are presented. Author

N65-11470# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DEFINITION OF BOUNDARY OF NUCLEUS OF FLOW AND COEFFICIENT OF PRESSURE RECOVERY IN SHORT ROUND CHANNELS
B. S. Vinogradov 21 May 1964 8 p Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 4, 1962 p 151–154
(FTD-MT-63-296; AD-605878)

Simple formulas are developed to find the boundary position of the nucleus of a flow with a minimum of experimental points, and also to make possible calculations for the coefficient of pressure recovery. These formulas are developed for axially symmetric channels, but they can also be extended to other cases. It is especially recommended that the developed formulas be applied to a system that uses pneumatic combs or tubes. G.G.

N65-11497*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ANALYSIS OF THE DIMENSIONAL ISENTROPIC FLOW WITH TABLES FOR PARTIALLY IONIZED ARGON
A. B. Witte 30 Sep. 1964 280 p refs
(Contract NAS7-100)
(NASA-CR-59611; JPL-TR-132-661) OTS Prices: HC $6.00/MF $1.50

One-dimensional isentropic-flow variables of partially ionized argon have been calculated by coupling the isentropic flow equations with the partition-function method of deriving equilibrium thermodynamic properties. Tabulated gas properties and flow variables are presented for stagnation conditions of 0.1, 0.5, 1.0, 2.0, and 3.0 atm pressure and temperatures from 6000° to 14 000° K in 1000° K increments. The gas properties computed for this flow process include the sound speed, entropy, enthalpy, electron concentration, ionization fraction, electrical conductivity, and static-to-stagnation ratios of temperature, pressure, and density. Tabulated flow variables include velocity, mass flux, area ratio, and Reynolds number per centimeter. Curves as well as tabulated results are included that show the data for increments of $\Delta T/T_T$ of 0.01 between stagnation conditions, and for an exit static temperature of 1000° K. Compared to results obtainable from perfect gas relationships (neglecting excitation and ionization), the results indicate that electronic excitation, expecially ionization effects, significantly alter the flow variables, particularly at the lower stagnation pressures and higher temperatures considered. However, with the exception of the effect of one excited state (the first excited state of the ion) on the equilibrium-composition equation, the thermodynamic properties calculated by neglecting excitation yielded results that were within 1% of those predicted by including excitation. Author

N65-11503# Massachusetts Inst. of Tech., Cambridge
RESEARCH IN PRESSURE-CONTROLLED FLUID JET AMPLIFIERS Final Report
Forbes T. Brown and Anton K. Simson Nov. 1963 190 p refs
(Contract DA-19-020-ORD-5659)
(DSR-9213-1; AD-605860) OTS: $6.00

A subsonic, pressure-controlled, fluid jet amplifier is analyzed to determine the important design parameters. Once these parameters are known, they are considered in terms of stability, linearity, and gain, to determine the optimum design configurations. Water-table experiments and observations are used to help determine the proper analytical models. Air models were also used to verify results. Author

N65-11507# Massachusetts Inst. of Tech., Cambridge Fluid Dynamics Research Lab.
PARAMETRIC AMPLIFICATION OF SURFACE AND INTERNAL WAVES Final Scientific Report

R. E. Kelly Jun. 1964 121 p refs *Its* Fluid Dyn. Res. Lab. Rept.-64-3
(Grant AF-AFOSR-156-63)
(AFOSR-64-1662; AD-605728) OTS: $4.00

The report concerns the possible amplification of waves in fluids due to fluctuations with time of some parameter, which defines, in part, the natural frequencies of the system. Resonance is most likely to occur when some characteristic frequency is half of the frequency of parametric variation. First, the fluid is taken to be within a container that oscillates in the vertical direction so that the gravitational acceleration, relative to the container, varies with time. Both surface waves, in the case of an interface, and internal waves, in the case of a continuous variation of density, are considered. Secondly, two fluids of different densities are taken to flow parallel to each other in an oscillatory manner and with different mean values of velocity. Author

N65-11574# Therm, Inc., Ithaca, N.Y. Therm Advanced Research Div.
ON THE FINAL STAGE DECAY OF GRID PRODUCED TURBULENCE Final Report
H. S. Tan and S. C. Ling Feb. 1963 40 p refs
(Contract Nonr-3583(00))
(TAR-TR-636; AD-421432)

A kinetic model of the final stage decay of grid-produced turbulence is presented. Theoretical analysis leads to an inverse-square energy-decay law. The prediction has been confirmed by measurements in a low-speed water channel. A replot of the Dryden–Schubauer and Batchelor–Townsend wind-tunnel data also indicates better agreement with the present inverse square, rather than the (5/2)-power decay law proposed by earlier investigators. Author

N65-11577# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BOUNDARY LAYER EQUATIONS AND BOUNDARY CONDITIONS FOR THEM IN THE CASE OF MOTION IN A SLIGHTLY RAREFIED GAS WITH SUPERSONIC SPEEDS
Yu. P. Lun'kin 16 Jan. 1964 17 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 21, no. 5 p 597–605
(FTD-MT-63-184; AD-605875)

Using Prandtl theories, boundary-layer equations are obtained for a slightly rarefied gas moving with supersonic speed. The equations differ from ordinary Prandtl equations by the presence of additional terms that contain higher derivatives of the speed and temperature. In the equations, the normal pressure gradient is different from zero and is expressed by additional terms. Kinetic theory is used to find the boundary condition for the equations. P.V.E.

N65-11592# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CALCULATION OF A TURBULENT BOUNDARY LAYER FOR SUBSTANTIAL POSITIVE PRESSURE GRADIENTS
S. S. Kytateladze and A. I. Leont'ev 18 May 1964 15 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 5, no. 1, Jan. 1962 p 33–41
(FTD-MT-64-49; AD-605877)

A discussion is presented of new method of calculating a turbulent boundary layer. The method is based on the boundary laws of friction and heat transfer in the diffusion region of a gas flow. Values are obtained of critical parameters at point of abruption of a turbulent boundary layer, and the influence of heat transfer and compressibility of the gas on these parameters is established. It is shown that the law of heat transfer in the practical region of variation of the criterion Re^{**} depends slightly on the pressure gradient. Methods are proposed for the calculation of friction and heat transfer, based on the solution of integral relationships of momenta and energy, with the use of boundary laws of friction and heat transfer. Author

N65-11603# Johns Hopkins U., Baltimore, Md.
TWO TURBULENT SHEAR FLOWS. I: A PLANE JET. II: A RADIAL JET
Gunnar Heskestad Jun. 1963 160 p refs
(Contract AF 49(638)-248)
(AD-605595)

Results from hot-wire measurements in a plane turbulent jet and a radial turbulent jet are reported. The plane jet was found to be approximately self-preserving sufficiently far downstream, where measurements of the intermittency and data for calculating the energy balance of the turbulent motion were made. Measurements were also made of the Reynolds number effect on the center-line development of the turbulent intensity and the flatness factor of the velocity derivative at a fixed, downstream, center-line location. The radial jet was observed not to attain the degree of self-preservation noted for the plane jet in the range of the measurements. The mean velocity profiles were quite similar, but the mean-square turbulent velocity profiles were similar only away from the center-line; the lateral intermittency distributions were highly dissimilar. Data for the energy balance was obtained at a convenient downstream location. Author

N65-11636# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
NONEQUILIBRIUM WAKES WITH LAMINAR AND TURBULENT TRANSPORT
Hwaachii Lien, John I. Erdos, and Adrian J. Pallone 22 Jan. 1964 46 p refs
(Contract AF 04(694)-239)
(RAD-TM-63-87; AD-606072)

The problem of the wake of a reentry vehicle is briefly reviewed, and an analysis is formulated for the solution of the nonsimilar, nonequilibrium viscous flow equations with laminar and turbulent transport. The air is treated as a mixture of eight components (N_2, N, O_2, O, NO, NO^+, e^-, and O_2^-) in which the vibrational and electronic excitation modes are assumed in equilibrium with the translational mode. For the calculation of the rate of formation of each species, the reaction rates based on the most recent measurements are employed. Numerical results are presented for the wake of a 15-ft, 8° (half-angle) cone at 22 000 fps, for altitudes of 150 000 and 15 000 ft. Based on the results of a recent correlation of wake transition data, instantaneous transition from laminar to turbulent flow is assumed to occur 250 ft from the cone vertex at 150 000 ft altitude, and 50 ft from the vertex at 115 000 ft altitude. Author

N65-11637# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
DETERMINATION OF THE EFFECTS OF CHEMICAL AND VIBRATIONAL RELAXATION ON AN INVISCID HYPERSONIC FLOW FIELD (TASK 3.1—FLOW FIELD ANALYSES—REST PROGRAM)
A. D. Wood, J. F. Springfield, and A. J. Pallone 22 Jan. 1964 55 p refs
(Contract AF 04(694)-239)
(RAD-TM-63-88; AD-606071)

The conservation equations for an inviscid, nonconducting fluid with chemical and vibrational relaxation are put into characteristic form for the determination of hypersonic flow

fields. Application of the analysis to the simpler case of vibrational equilibrium is also discussed. As an approximation for obtaining numerical solutions, the nonequilibrium terms in the compatibility relations along the Mach line characteristics are neglected, reducing them to the well-known frozen form. The pressure and flow angle are calculated by local application of these relations, assuming proper values of the speed of sound based on the local composition of the relaxing gas. A coupled nonequilibrium calculation is carried out simultaneously along the streamline characteristic in which the rate equations for individual species production and vibrational relaxation, together with the energy equation, are used to obtain translational and vibrational temperatures and species concentrations, thereby completely determining the state of the gas. Results at typical entry conditions in the Earth's atmosphere are presented for pointed bodies with and without vibrational equilibrium, and for blunted bodies with vibrational equilibrium. Comparisons are made with results from frozen and equilibrium analyses. The effects of both chemical and vibrational relaxation, and variation of nose bluntness, on the downstream composition of the gas are shown to be appreciable. A comparison with results of a simpler one-dimensional, nonequilibrium streamtube analysis indicates that the latter is adequate in many cases. Author

N65-11651# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MECHANICS AND MECHANICAL ENGINEERING Selected Articles
7 Jan. 1964 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk. SSSR, OTD. Tekhn. Nauk. Mekhan. i Mashinostr. (Moscow), no. 6, 1962 p 17–24, 144–146
(FTD-MT-63-90; AD-606754)

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2. ON MOTION OF A SHOCK WAVE DURING NONINSTANTANEOUS OPENING OF A DIAPHRAGM IN SHOCK TUBE V. T. Kireev p 15–20 refs (See N65-11653 02-11)

N65-11652# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-SPEED AND THERMAL BOUNDARY LAYER ON AN AXIALLY SYMMETRIC BODY, ROTATING IN UNLIMITED MOTIONLESS MEDIUM
L. A. Dorfman *In its* Mechanics and Mech. Eng. 7 Jan. 1964 p 1–14 refs (See N65-11651 02-12)

Solutions are presented of problems for an arbitrary axially symmetric body rotating in a viscous incompressible liquid under laminar and turbulent regimes. A comparison is made of the calculation of the laminar boundary layer on a rotating sphere with reported experimental measurements. D.S.G.

N65-11671# Northwestern Technological Inst., Evanston, Ill. Gas Dynamics Lab.
GENERALIZED SELF-SIMILARITY AND SOLUTIONS FOR MAGNETOGASDYNAMIC FREE JETS
William F. Hug [1964] 79 p refs
(Grants AF-AFOSR-62-307; AF-AFOSR-63-329)
(NU-GDL-B-3-64; AD-608170)

The general conditions under which self-similitude can be expected are investigated. Through the simple development of equations presented here, two undocumented solutions have been shown to be available. The solutions are these: (1) The subsonic gasdynamic free jet with nonunitary Prandtl number and a viscosity that is proportional to the square root of temperature—solution to this problem is given in closed form in the incompressible von Mises solution plane with a transformation back to physical coordinates accomplished by numerical integration. (2) The subsonic magnetogasdynamic free jet with nonunitary Prandtl number—a viscosity that is proportional to the square root of temperature, and an electrical conductivity that is proportional to the square root of the temperature cubed. Author

N65-11683# Technische Hochschule Aachen (W. Germany)
SOLUTION OF THE SOMMERFIELD-SEXL CHARACTERISTIC EQUATION FOR THE STABILITY OF COUETTE FLOW Annual Summary Report, 1 Sep. 1963–31 Aug. 1964
F. Schultz-Grunow Aug. 1964 26 p refs
(Contract AF 61(052)-744)
(ASR-4; AD-605831)

A theoretical stability proof, which avoids any assumptions based on a Rayleigh perturbation, is presented for the intrinsic stability problem of Couette flow (in the region of its transition to turbulence jet). Flow between concentric cylinders is considered. The Sommerfield–Sexl transcendental equation that yields the stability parameters of Couette flow is transformed. A series expansion in the distance between the walls of the two cylinders is obtained. The series solution (in polynomial form) can be solved numerically for any mode and width of gap. For a ratio of the inner and outer radius of 2, the stability is found for the first and third mode. P.V.E.

N65-11755# AiResearch Mfg. Co., Los Angeles, Calif.
FLOW STABILITY IN MULTITUBE FORCED-CONVECTION VAPORIZERS
P. J. Berenson Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Oct. 1964 87 p refs
(Contract AF 33(615)-1551)
(L-9448; APL-TDR-64-117; AD-607769)

This report describes work undertaken to resolve the SNAP-50/SPUR liquid-metal boiler two-phase flow stability problems. A review is presented of existing literature pertaining to forced-convection vaporization heat transfer and two-phase flow stability. Dimensionless simulation criteria are defined on the basis of the significant parameters determined from the survey. The test program, in which Freon 113 was used as the test fluid, and in which the values of the dimensionless two-phase flow stability parameters applicable to the SNAP-50/SPUR boiler were simulated, is presented. The design of the transparent closed test loop, which incorporates a five-tube boiler, is described. Conclusions and discussions are presented, based on the measured data and the high speed photographs of two-phase flow in both plain tubes and tubes with twisted tape inserts. These indicate that stable flow can be achieved in the SNAP-50/SPUR boiler by inserting at the entrance of each boiler tube an orifice that has a pressure drop between 100% and 200% of the two-phase pressure drop. Author

N65-11762# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ESTABLISHING A CONSISTENT COMPRESSION-EXPANSION FORMULA FOR THE SUPERSONIC-HYPERSONIC REGIME
Elie Carafoli 15 Oct. 1964 12 p refs Transl. into ENGLISH from Comun. Acad. Rep. Populare Romine (Bucharest), v. 12, no. 9, 1962 p 985–993
(FTD-TT-64-668/1+2+3+4; AD-607543)

A simple form of the general equation for shock waves is derived that has the advantage of being applicable to a wide interval of angles. The simple form of the equation is valid for compression behind the shock wave and for expansion. D.E.W.

N65-11785# California U., Berkeley Inst. of Engineering Research
A REPRESENTATION OF ROTATION AND CURVATURE IN FLUID FLOWS AND CONNECTION WITH VORTICITY AND DISSIPATION
Paul Lieber and Kirit Yajnik 11 Mar. 1964 45 p refs
(Contract Nonr-222(87))
(MD-63-7; AD-605364)

This report attempts to show connections between vorticity, the rotation of a line element, the curvature of a streamline, and dissipation in viscous fluid flows. A tensor of third rank is shown to determine the angular velocity of a differential element of a filament (curve) of a moving material, if the current direction of the differential element is known. The same tensor determines the curvature of streamline at a point, if the velocity of the fluid at that point is given. This tensor may then be said to represent rotation and curvature in a fluid flow. Dilatation does not influence the tensor. The dissipation function of an incompressible Newtonian fluid can be expressed in terms of its second-order invariants. Author

N65-11785# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
PERIODIC BOUNDARY LAYER FLOWS OVER A FLAT PLATE
Vivian O'Brien and F. Eugene Logan May 1964 117 p refs
(Contract NOw-62-0604-c)
(CM-1045; AD-607065)

An oscillating flat-plate apparatus allows study of the periodic laminar flows of viscous fluids induced by the plate motion. The measurements and their comparison with parallel flow theory clearly show that the periodic flow is a combination of oscillating flow and pulsating flow. The parameter for similarity predicted from the laminar theory seems justified, but above a critical frequency the flow becomes less regular. This parameter alone is not adequate to describe the time-dependent flow. Author

N65-11786# Princeton U., N.J.
BACKGROUND AND SAMPLING EFFECTS IN FREE JET STUDIES BY MOLECULAR BEAM MEASUREMENTS
John B. Fenn and James B. Anderson Sep. 1964 34 p refs Presented at the 4th Intern. Symp. on Rarefied Gas Dyn., Toronto U., 14–17 Jul. 1964
(Contract Nonr-3623(00); Proj. Squid)
(PR-108-P; AD-607204)

The effects of finite background pressures on free supersonic jets from sonic nozzles have been investigated. At sufficiently low jet densities, which have been characterized in terms of nozzle Knudsen number, axial distance, and background pressure level, the background gas freely invades the jet flow field. This invasion results in substantial scattering of the jet molecules with the consequence that molecular beams extracted from such jets suffer a marked attenuation of their intensity. Some possible implications with respect to previously observed species separation are discussed. Author

N65-11873*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CORRELATION OF SONIC-BOOM THEORY WITH WIND-TUNNEL AND FLIGHT MEASUREMENTS
Harry W. Carlson Washington, NASA, Dec. 1964 27 p refs
(NASA-TR-R-213) OTS Prices: HC $0.75/MF $0.50

A study was made of the accuracy and reliability of current theoretical methods of estimating sonic-boom overpressures for level flight at a constant supersonic Mach number. Theoretical estimation methods were outlined, and a numerical evaluation of sonic-boom theory for use on high-speed electronic computing machines was introduced. Estimates based on this theory were compared with available wind-tunnel and flight measurements. The correlation was made with wind-tunnel data that incorporate improved data-reduction methods. The dependence of sonic-boom overpressure on configuration geometry was also discussed, and design methods of minimizing the problem were explored. Author

N65-11953# Southampton U. (Gt. Brit.)
SOME PRACTICAL APPLICATIONS OF BOUNDARY LAYER PRESSURE FLUCTUATION WORK
E. J. Richards and P. E. Doak Mar. 1963 52 p refs
(AASU-235)

This paper presents a survey of knowledge concerning the influence of the fluctuating boundary forces on the response and fatigue of a supersonic airplane, as well as the noise radiated into the cabin as a result of these structural vibrations. G.G.

N65-11989# Brown U., Providence, R.I.
A GENERAL SOLUTION OF THE HOPF CHARACTERISTIC FUNCTIONAL EQUATION FOR TURBULENCE
Iwao Hosokawa May 1964 19 p refs
(Contract AF 49(638)-1295)
(AFOSR-64-1113; WT-39; AD-447664)

The aim of this paper is to point out that a general solution of the Hopf ϕ equation in turbulence theory already exists in his definition of the characteristic functional, and that Hopf's definition is equivalent to Rosen's solution. The decay of isotropic turbulence is considered based upon Hopf's integral representation to show the usefulness of this method. The advantage of using either representation depends upon the particular case being analyzed. Author

N65-11996# Massachusetts Inst. of Tech., Cambridge Fluid Dynamics Research Lab.
SOUND PROPAGATION IN RAREFIED MONATOMIC GASES Final Report
Saul S. Abarbanel and Kuei-Yuan Chien Aug. 1964 53 p refs *Its* Fluid Dyn. Res. Lab. Rept.-64-6
(Contract AF 19(604)-5698)
(AFCRL-64-765; AD-451023)

The dispersion and attenuation of sound in rarefied gases is sought on the basis of kinetic theory. The perturbations of the velocity distribution function are assumed to be one dimensional in velocity space. In the case of the Maxwellian gas, the method is applied in the Knudsen regime, and the results are in good agreement with experiments and the complete three-dimensional theory. It is shown that the Knudsen regime is not defined merely as the case of small acoustic Reynolds number. Rather, there is an additional controlling dimensionless parameter that is important in delineating the various flow regimes. The case of the hard-sphere gas is also considered, and it is shown that the assumption of unidirectional velocity perturbation makes it possible to cast the problem as a Fredholm integral equation possessing complex eigenvalues. Author

N65-11998# Union Carbide Research Inst., Tarrytown, N.Y.
STAGNATION-POINT-VELOCITY DISTRIBUTION FOR A COMPRESSIBLE FLUID
R. A. Graff Oct. 1964 11 p refs
(Contract DA-30-069-ORD-2787)
(C-24; AD-449869)

The Rayleigh–Janzen method is applied to the potential flow of a compressible fluid impinging on a flat plate at right angles. An analytical expression for the velocity distribution is obtained up to the second perturbation. Author

N65-12036# Wisconsin U., Madison Mathematics Research Center

NUMERICAL STUDY OF THE NAVIER-STOKES EQUATIONS FOR THE PRODUCTION OF SMALL EDDIES FROM LARGE ONES

P. C. Jain Jul. 1964 39 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-491; AD-607807)

To investigate the process of grinding down of large eddies into smaller ones at high Reynolds numbers, a finite difference method is used to obtain the periodic solutions of the Navier–Stokes equations numerically when the initial motion is assumed to be $v_1 = \cos x \sin y \sin z$, $v_2 = -\sin x \cos y \sin z$, and $v_3 = 0$. Mean-square kinetic energy and mean-square vorticity are calculated, and it is found that the numerical method provides estimates of these quantities up to $t = 1.90$ at $R = 200$ and up to $t = 1.70$ at $R = 1000$. Several other initial sets of vortices are used to find the behaviour of λ, λ_n/λ, and K at $t > 0$. Author

N65-12044# Polytechnic Inst. of Brooklyn, N.Y.

ON THE MOTION AND DECAY OF A VORTEX IN A NONUNIFORM STREAM Final Report

Lu Ting and Chee Tung Aug. 1964 63 p refs
(Grant WBG-24)
(PIBAL-851; AD-450704)

A systematic procedure is presented for the study of the motion of a vortex in a two-dimensional, incompressible, nonuniform stream as a solution of the Navier–Stokes equations by the introduction of a small parameter ϵ, which is inversely proportional to the square root of the Reynolds number of the vortex. Two different sets of length and time scales are introduced. The set with longer length and time scales is identified with the typical scales of the outer nonuniform flow. The ratio of the two length scales and that of the time scales are powers of the small parameter ϵ. By the expansion of the solutions in the power of ϵ with appropriate time and length scales, it is shown that the outer solution of the Navier–Stokes equations will be the same as the inviscid solution, and the leading term in the inner solution agrees with that of a decaying axially symmetric vortex. The singularity associated with an inviscid vortex is removed. Author

N65-12049# Illinois U., Urbana

DYNAMICS OF MULTI-PHASE FLOW SYSTEMS

S. L. Soo Sep. 1964 41 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(ILL-18-P; AD-607234)

General motion of nonreactive gas–solid systems in potential fields with distribution in size of solid particles was formulated through the introduction of multi phase generalization. Cases of adiabatic potential flow, laminar boundary layer motion, and electrohydrodynamic slug flow were illustrated, and the physical significance of results was discussed. Results demonstrate the feasibility of treating such a flow system rigorously. Author

N65-12087*# National Aeronautics and Space Administration. Washington, D.C.

REPRESENTATION AND CALCULATION OF THE SPECTRAL DENSITY OF THE FIELD OF ATMOSPHERIC TURBULENCE BASED ON THE RESULTS OF AIRCRAFT FLIGHT TESTS [REPRESENTATION ET CALCUL DE LA DENSITE SPECTRALE DU CHAMP DE TURBULENCE ATMOSPHERIQUE A PARTIR D'ESSAIS EN VOL SUR AVION]

Raymond Andre and Albert Jouan Dec. 1964 29 p refs Transl. into ENGLISH from Rech. Aerospatiale (France), no. 98, 1964
(NASA-TT-F-256) OTS Prices: HC $0.75/MF $0.50

This article presents a method of investigating the field of atmospheric turbulence based on the results of high-speed flights in a turbulent atmosphere. The essence of the method consists of calculating the spectral density of the correlation functions characterizing the turbulence by way of the response of the aircraft regarded as a measuring instrument. The physical assumptions and the mathematical model that will best fit the phenomenon are discussed. A semianalog analysis chain giving the spectral density of a stationary random process is described. Author

N65-12115# Argonne National Lab., Ill. Reactor Engineering Div.

THE GRAETZ PROBLEM IN COCURRENT-FLOW, DOUBLE-PIPE, HEAT EXCHANGERS

Ralph P. Stein Sep. 1964 45 p refs
(Contract W-31-109-ENG-38)
(ANL-6889) OTS: $2.00

It is shown that the Graetz Problem pertaining to the cocurrent-flow, double-pipe heat exchanger can be studied analytically by extensions of familiar mathematical techniques. These techniques are used to derive a formal analytical solution of the problem, and numerical results are obtained. The results demonstrate the following: (1) Fully developed, laminar-flow, heat-transfer (film) coefficients in cocurrent-flow, double-pipe heat exchangers depend upon the operating conditions of the exchanger, and their values can be significantly less than the value corresponding to the boundary condition of uniform wall temperature. (2) Use of customary design equation applied to laminar-flow heat exchangers can result in large errors even when the heat transfer is fully developed, and these errors will be largest when actual, fully developed, heat-transfer coefficients are used. Author

N65-12122# Johns Hopkins U., Baltimore, Md.

MAGNETOHYDRODYNAMIC AND PLASMA TURBULENCE

Leslie S. G. Kovasznay Sep. 1964 23 p refs Presented at the 11th Intern. Congr. of Appl. Mech., Munich, 30 Aug.–5 Sep. 1964
(Contract Nonr-3623(00); Proj. Squid)
(JHU-23-P; AD-606395)

A review of the development in turbulence of electrically conducting media is given for the last 4 to 5 years. Theories of homogeneous turbulence, both passive and active are summarized. The chemical approach in hot wakes and the possibility of electrostatic turbulence are also reviewed. Author

N65-12140# Argonne National Lab., Ill. High Energy Physics Div.

INDEX AND DISPERSION OF SOME CERENKOV COUNTER GASES

E. R. Hayes, R. A. Schluter, and A. Tamosaitis Aug. 1964 40 p refs
(Contract W-31-109-ENG-38)
(ANL-6916) OTS: $2.00

The index of refraction, n, and the dispersion of several Cerenkov counter gases were precisely measured by the interferometric method. The precision is typically four parts in $(n-1) \times 10^5$. The gases investigated include Freon 11 (CCl_2F_2), Freon 13 ($CClF_3$), Freon 13B1 ($CBrF_3$), Freon 22($CHClF_2$), Freon 116 (CF_3-CF_3), as well as nitrogen, carbon dioxide, and dry air. Measurements of n were made at 5460, 4360, 4050, 3650, and 3125 Å. For Freon 13 and carbon dioxide the measurements were carried to pressures near the critical point. Author

N65-12146# Princeton U., N.J. Gas Dynamics Lab.

LAMINAR SEPARATED FLOW WITHIN REJOINING OR REATTACHING BOUNDARY LAYERS

Sin-I Cheng Jul. 1964 41 p refs *Its* Rept.-701
(Contract AF 49(638)-1271)
(AFOSR-64-1596; AD-608208)

The separated flow next to the point where the supersonic boundary layers rejoin or reattach is examined around the stagnation point that is enclosed between the boundary layers, using the Navier–Stokes equations. For the separated recirculating flow to be dynamically possible, it was found that at the rear stagnation point, the rejoining wake flow must possess a parabolic dividing streamline, a proper axial pressure gradient, and an outer inviscid stream parallel to the axis of symmetry of the recirculating flow. A model for the analysis of the recirculatory wake is discussed. Sample results compare favorably with some limited data. A similar model may be constructed for analyzing the separated flow over a solid body terminated by boundary-layer reattachment. D.E.W.

N65-12150# Aeronautical Research Associates of Princeton, Inc., N.J.
ON THE MOTION WITHIN FLUID GYROSCOPES
Martin Fiebig Aug. 1964 84 p refs
(Contract AF 49(638)-1262)
(ARAP-62; AFOSR-TN-64-1457; AD-608703)

The flow field that results from the disturbance of an initially laminar, viscous, incompressible sink flow through a cylindrical chamber is investigated. The disturbance considered may arise either from an impulsive motion or a harmonic oscillation of the device perpendicular to its axis of symmetry. The results of this investigation indicate the general behavior of the response of the flow field within such a device over a wide range of the governing parameters. In particular, it is shown that the mean time lag or phase lag of the motion is nearly identical with the inviscid transport time, whereas the mean amplitude of the response is almost proportional to the inverse distance from the axis when the viscogeometric parameter is smaller than 10^{-1}. Author

N65-12157# Brown U., Providence, R.I. Div. of Engineering
THE METHOD OF FUNCTIONALS IN TURBULENCE THEORY
Iwao Hosokawa May 1964 40 p refs
(Contract AF 49(638)-1295)
(AFOSR-64-1396; WT-41; AD-607643)

The generalized characteristic functional for random fields is formulated. The formulation is a generalization of the theory of Hopf and includes space correlations, as well as time correlations of the fields. It is shown that the gaussian functional solution can exist for incompressible, inviscid Navier–Stokes turbulence. An exact particular solution to the characteristic functional is developed, and a general solution is constructed by superposition of the particular solution. P.V.E.

N65-12191# Cincinnati U., Ohio Research Foundation
A CRITICAL ASSESSMENT OF THE PROBLEM OF SHARP LEADING EDGE OF A FLAT PLATE IN HYPERSONIC FLOW
A. C. Jain and T. Y. Li Jul. 1964 42 p refs
(Contract Nonr-2168(03))
(AE-6401; AD-608294)

The advent of vehicles moving many times the velocity of sound makes it necessary to understand clearly the various phenomena occurring near the sharp leading edge of a flat plate. A few theoretical attempts to tackle this problem are made, and several experiments are performed at various places. Unfortunately, wide areas of disagreement exist between the various theoretical investigations and the experimental results. It is the purpose of this note to gather some useful information from the available literature on this subject, and to present some suggestions that might be useful or worth consideration in any future attempt to solve this problem. Author

N65-12220# Stevens Inst. of Tech., Hoboken, N.J. Davidson Lab.
INTERNAL WAVE FIELD OF A DIPOLE IN A FLUID WITH AN EXPONENTIALLY VARYING DENSITY, I
C. E. Grosch Sep. 1964 36 p refs
(Contract Nonr-263(53))
(R-1042; AD-448599)

The three-dimensional internal wave field generated by a dipole moving with a velocity U in a fluid of depth L, whose density varies exponentially, is considered. In this report, only the pure internal waves are considered; i.e., it is assumed that the free surface is undisturbed. It is shown that the nature of the waves generated by the motion depends on a Froude number $F = U[gL(\Delta\rho/\rho_0)]^{-1/2}$, where g is the acceleration of gravity, $\Delta\rho$ is the change in density from the free surface to the bottom, and ρ_0 is the average fluid density. If f is less than π^{-1}, transverse and diverging waves exist; and if F is greater than π^{-1}, there are only diverging waves. The far field of the waves is considered in some detail. Author

N65-12232# Marine Engineering Lab., Annapolis, Md.
NOISE CONSIDERATIONS IN METHODS OF REGULATING FLUID FLOW
R. A. Milroy 1 Oct. 1964 54 p
(MEL-176/64; AD-447896)

Nine methods for regulating fluid flow are presented. They are designated as original, mechanical, orificial, frictional, recirculational, oscillational, accelerational, transitional, and magnetical. Each method is explained together with its flow noise characteristics. Pertinent experimental studies of devices demonstrating several of the methods are included. Author

N65-12252# Mississippi U., University
THERMAL RELAXATION PROCESSES IN GASES. A NUMERICAL SOLUTION FOR SOUND VELOCITY AND ABSORPTION IN CYLINDRICAL TUBES
F. D. Shields, K. P. Lee, and W. J. Wiley 22 Sep. 1964 17 p refs
(Contract Nonr-3078(01))
(AD-448054)

A numerical solution of the Kirchhoff equation for the propagation constant of longitudinal sound waves in infinitely long cylindrical tubes has been obtained. The solution, which avoids the wide tube approximations, shows that the percentage errors in the Helmholtz–Kirchhoff tube-velocity correction and tube-absorption are both roughly equal to the velocity correction percentage of the free-space velocity. The error in the Helmholtz–Kirchhoff equations is found to be a function of fD/a, $pD/\eta a$ and γ. (f = sound frequency, D = tube diameter, a = free-space velocity, p = gas pressure, η = viscosity and γ = ratio of specific heats.) Recent absorption measurements in Ar are in agreement with values calculated numerically. But measured velocities indicate the need for considering molecular slip at the tube wall. Author

N65-12273*# National Aeronautics and Space Administration, Washington, D.C.
STEADY MOTION OF A VISCOUS CONDUCTING FLUID IN RECTANGULAR PIPES UNDER THE INFLUENCE OF A TRANSVERSE EXTERNAL MAGNETIC FIELD [OB USTANOVIVSHEMSYA TECHNII VYAZKOY PROVODYASHCHEY ZHIDKOSTI PO PRYAMOLINEYNYM TRUBAM, NAKHODYASHCHIMSYA V POPERECHNOM VNESHNEM MAGNITNOM POLE]

G. A. Grinberg Dec. 1964 24 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 34, no. 10, 1964 p 1721–1731
(NASA-TT-F-9209) OTS Prices: HC $1.00/MF $0.50

The flow in a pipe of arbitrary cross section with nonconducting walls is discussed. If the velocity v and induced magnetic field Y are parallel to the axis of the pipe and the external field is uniform, the solution of the problem essentially involves determination of the Green's function for the two-dimensional equation $\Delta\psi - M^2\psi = 0$ and the corresponding region (M is the Hartmann number). An integral equation is given for the derivative of the Green's function normal to the contour, through which the entire solution is expressed in quadratures. For the case of large M, a rapidly converging process of successive approximations is presented, and an asymptotic solution of the integral equation is obtained by means of which it is possible to find the values v and H at any point within the pipe. The case of a rectangular pipe, for which the Green's function is determined precisely, also is considered. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-10973# Naval Ordnance Lab., Corona, Calif. Research Dept.
MICROWAVE TEMPERATURE MAPPING WITH AN AIRBORNE ANTENNA
J. B. Roberts 15 Oct. 1963 36 p refs
(NOLC-590; AD-424765)

The application of microwave radiometry to terrain mapping from an airborne vehicle is discussed. An attempt is made to set up an appropriate mathematical model of the scanning situation and to derive equations describing it. Several of these equations are used to calculate such quantities as the optimum scan rate, the energy available for activating a detector, and the temperature and space resolution capabilities of a finite-beam-width antenna. Author

N65-10976# Sandia Corp., Albuquerque, N. Mex.
RE-ENTRY FLIGHT DEMONSTRATION NUMBER ONE (RFD-1): ATMOSPHERIC SCIENCES SUPPORT
C. A. Coonce Oct. 1964 23 p refs
(SC-RR-64-517) OTS: $2.00

The data for the four systems used to gather atmospheric data from Bermuda in support of RFD-1 are presented. The four systems used were radiosonde balloons, and Arcas–Robin, Kisha–Judi densitometer, and Deacon–Judi chaff rockets. The radiosonde density data agree well with the U.S. Standard Atmosphere for 1962, up to the limit of 100 000 feet. The Kisha-Judi densitometer and the Arcas–Robin density reduction data compare well with each other, and with the U.S. Standard Atmosphere for 1962. It is safe to conclude that for the reduction of RFD-1 data, the U.S. Standard Atmosphere for 1962 can be used with a minimum of error. Author

N65-11017# Intermountain Weather, Inc., Salt Lake City, Utah
THE INFLUENCE OF HAZE ON INFRARED RADIATION MEASUREMENTS DETECTED BY SPACE VEHICLES Final Report
Wilford Zdunkowski, Donald Henderson, and J. Vern Hales Jul. 1964 76 p refs
(Contract CWB-10648)
(AD-605688)

A method is outlined to investigate the influence of thin cirrus layers, invisible to the naked eye, upon the long-wave flux leaving the atmosphere. Radiative properties of spherical ice particles acting as primary scatterers and absorbers of infrared radiation were taken into account. The combined radiative effects of ice particles with gaseous absorbers were estimated to determine the influence of thin cirrus layers on the outgoing long-wave radiation within the 6.0μ to 6.5μ and 8μ to 12μ region, as well as the total infrared spectrum. An estimate is also made of the effect of the stratospheric haze layer upon the outgoing radiation. Author

N65-11038# Saskatchewan U., Saskatoon (Canada) Inst. of Upper Atmospheric Physics
THE ANALYSIS OF TIME SEQUENCES WITH REFERENCE TO GEOPHYSICAL APPLICATIONS
K. V. Paulson Apr. 1964 76 p refs
(Grant DRB-9511-25)
(RS-12)

This study presents methods to be used for the analysis of "second-order stationary" time sequences, and their application to geophysical problems of the upper atmosphere. The principle of quantum mechanics for geophysical observations is discussed. Emphasis is placed on the recording of upper-atmosphere data on a reproducible, broadband, magnetic-tape recording and storing them in analog or digital form. The data analysis through the application of probability methods, based on the spectral analysis, is developed by the use of stochastic processes. G.G.

N65-11196# Joint Publications Research Service, Washington, D.C.
COMPUTATION OF THE GROWTH OF DROPLETS AND SPHERICAL ICE PARTICLES IN CONVECTIVE CLOUDS USING THE "URAL-1" COMPUTER
Yu. A. Barukova and T. S. Uchevatkina 25 Nov. 1964 18 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 145, 1963 p 3–12
(JPRS-27551; TT-64-51800) OTS: $1.00

This article presents the solution of the problem of the growth of drops and spherical particles in convective clouds on a Ural-1 electronic digital computer, and it gives the results of computations for cases with a constant and variable velocity of an ascending current. It also presents a simplification of the initial equations. Author

N65-11227# Bonn U. (W. Germany) Meteorological Inst.
EVALUATION OF AEROLOGICAL DATA WITH RESPECT TO THE EL NINO-PROBLEM Final Report
Karin Schütte [1962] 34 p refs
(Contract DA-91-591-EUC-2781)
(FR-2; AD-447435)

An evaluation of daily rainfall records from a number of stations in Ecuador and northern Peru has revealed the occurrence of marked local variations during an El Nino-period. In order to understand the synoptic processes responsible for the difference between rainy and rainless periods, a thorough investigation of upper winds at Guayaquil and Talara has been made, however, with inconclusive results. A significant interpretation of the complicated El Niño-conditions must be based on a more complete series of observations. Author

N65-11237# Weather Bureau, Washington, D.C. Meteorological Satellite Lab.
CALCULATIONS OF THE EARTH'S SPECTRAL RADIANCE FOR LARGE ZENITH ANGLES
D. Q. Wark, J. Alishouse, and G. Yamamoto (Tohoku U.) Oct. 1963 51 p refs
(MSL-21)

The infrared spectral radiance has been calculated near the limb of the earth, using a curved refracting atmosphere. Radiance was calculated in narrow spectral intervals for eight atmospheric models representing a wide range of meteorological conditions. Comparison is made of the radiance across the limb for four of the model atmospheres in several narrow spectral intervals; two hypothetical filters are then convoluted with spectral radiance to show the effective radiance across the limb, as it might be viewed by a horizon sensor. The results indicate that the 15μ carbon dioxide band and the rotational water vapor band are best suited for horizon sensing, and that neither is decisively superior on the basis of radiance. Author

N65-11275 Texas A&M Research Foundation, College Station
A STUDY TO IMPROVE THE LOW-LEVEL METEOROLOGICAL SIMULATOR Quarterly Report, 1 Jun.–31 Aug. 1963
William H. Clayton 30 Sep. 1963 22 p refs
(Contract DA-36-039-AMC-02195(E))
(QR-3; AD-424793)

The major activities were restricted to the windup of formal data-collection efforts from the Dallas Tower Network, and the decommissioning of all the stations of this network except stations A and B. Summarization of the specifics of these efforts as well as related research tasks is reviewed. These include wind-sensor evaluation tests, a study of the exchange coefficient relationships for momentum, heat, and vapor, and a study of the use of soil heat plates as direct flux-measuring devices. Author

N65-11301*# National Aeronautics and Space Administration, Washington, D.C.
FLUXES OF OUTGOING RADIATION AT VARIOUSLY ORIENTED SURFACES AT AN ALTITUDE OF 300 KILOMETERS [POTOKI UKHODYASHCHEGO IZLUCHENIYA NARAZLICHNO-ORIENTIROVANNYYE POVERKHNOSTI NA VYSOTE 300 KM]
K. Ya. Kondrat'yev and M. P. Fedorova Mar. 1964 11 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 1, no. 3, 1963 p 443–447
(NASA-TT-F-8832) OTS Prices: HC $1.00/MF $0.50

Results are presented of calculations of the fluxes of outgoing shortwave and longwave radiation at plane surfaces of various orientation, located in the atmosphere at a height of 300 km. The calculations are made for a given angular distribution of the intensity of the outgoing radiation. Conclusions are drawn concerning the possibility of using an isotropic approximation for computing the outgoing longwave radiation. Author

N65-11324# Joint Publications Research Service, Washington, D.C.
RELATIONSHIP BETWEEN THE ATMOSPHERE ELECTRIC FIELD AND CONDENSATION NUCLEI
Ye. V. Chubarina 25 Nov. 1964 15 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 157, 1964 p 22–30
(JPRS-27538; TT-64-51787) OTS: $1.00

This article presents comparisons between the vertical distribution of the strength of the electric field and the condensation nuclei in the atmosphere. There is a great similarity between the curves of the variation of the electric field and the change of the vertical concentration of condensation nuclei. The correlation coefficient between them is ~ 90%. The coincidence between the value of the computed (A) and the experimentally determined ($A' = E/Z$) proportionality factors for the electric field (E) and the concentration of condensation nuclei (Z)

$$(E = (\frac{i\delta}{\alpha k q}) \cdot Z, E = AZ, A = \frac{i\delta}{\alpha k q})$$

indicates that a change in the concentration of condensation nuclei acts on a change of air conductivity and thus on a change in the electric field. An attempt is made to estimate the mean dimensions of condensation nuclei. Author

N65-11332# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
GEO-ASTROPHYSICS LABORATORY PROGRESS REVIEW, FIRST SIX MONTHS 1964
J. C. Noyes, C. I. Beard, J. Gauger, L. E. Johnson, J. F. Kenney et al Aug. 1964 30 p refs

The following topics are presented: "Cosmic Ray Neutron Experiment"—a flux and energy survey of cosmic-ray neutrons in the atmosphere; "Radio Star Scintillations"—a radio interferometer system for the study of the transmission properties of the high atmosphere at high latitudes; "Microwave Scattering by Random Media"—the interrelation of the phase and magnitude statistics of the received radio waves with the medium characteristics; "Very Low Frequency Whistler Mode Echoes"—the data analysis of the recorded whistler mode echoes; "Lunar Temperature Program"—the data reduction of 1963 measurements; "Geomagnetic Micropulsations"—a recording station for the study of small perturbations of the earth's magnetic and telluric fields; and "Magnetohydrodynamic Flows"—a steady flow past an obstacle in an incompressible hydromagnetic fluid. G.G.

N65-11351# Northrop Corp., Palos Verdes Estates, Calif. Nortronics Div.
HIGH ALTITUDE DAYTIME SKY BACKGROUND RADIATION MEASUREMENT PROGRAM. PART II: SKY SPECTRAL RADIANCE DATA FROM RESEARCH VEHICLE NO. 1
15 May 1964 158 p
(Contract AF 33(657)-11081)
(AL-TDR-64-134, Pt. II; AD-604032)

This is a data presentation gathered in seven high-altitude flights of the research vehicle #1. The following sky-background data were obtained over various types of terrain, at various times of the day: spectral radiance of the sky between 350 nanometers and 750 nanometers, sky brightness, sky polarization, infrared radiance, albedo of the earth, and temperature inside the spectrophotometer. G.G.

N65-11446*# Consultants and Designers, Inc., Arlington, Va.
POLARIZATION MEASUREMENTS OF ZODIACAL LIGHT [POLYARIZATSIONNYYE IZMERENIYA ZODIAKAL'NOGO SVETA]
N. B. Divari, S. N. Krylova, and V. I. Moroz 10 Nov. 1964 8 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 5, 1964 p 881–885
(Contract NAS5-3760)
(NASA-TT-F-8989; ST-OA-ID-10237) OTS Prices: HC $1.00/MF $0.50

The results of polarization measurements of zodiacal light, conducted in 1955, are expounded. Determinations were made of the absolute brightness of zodiacal light in blue and green rays in polarized, as well as in natural, light. The course of brightness distribution of zodiacal light along the ecliptic and perpendicular to it was approximated by an analytical expression. The color of the zodiacal light is near that of the sun. The degree

of polarization at various points of the zodiacal light cone in the regions $15° \leq \beta \leq 25°$ and $30° \leq \epsilon \leq 65°$ was determined.
Author

N65-11447*# Consultants and Designers, Inc., Arlington, Va.
ON THE CONCENTRATION OF DUST IN THE UPPER ATMOSPHERE LAYERS [O KONTSETRATSII PYLI V VERKHNIKH SLOYAKH ZEMNOY ATMOSFERY]
N. B. Divari 11 Nov. 1964 11 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 5, 1964 p 886–891
(Contract NAS5-3760)
(NASA-TT-F-8990; ST-ID-10238) OTS Prices: HC $1.00/MF $0.50

On the basis of photometric measurements of twilight sky brightness, an estimate is made of dust concentration in the earth's atmosphere; the values of concentrations and of the spatial density of the dust in the 40- to 135-km altitude range are obtained. The concentration of dust with height, h, varies according to the law $\sim h^{-7.2}$. From a comparison of the data obtained with satellite measurements it is concluded that breaking up of particles of the near-terrestrial dust cloud or accumulation of fine particles by capture takes place at heights of 100 to 300 km above ground. The dust particles measured with the aid of satellites are not as effective as finer particles in the scattering of solar radiation in twilight conditions.
Author

N65-11458# National Oceanographic Data Center, Washington, D.C.
INTERNATIONAL COOPERATIVE INVESTIGATIONS OF THE TROPICAL ATLANTIC. VOLUME 1: EQUALANT 1 Data Report
Albert M. Bargeski and Daniel Roberts, III, comp. 1964 289 p refs Coordinated by the Intergovernmental Oceanographic Commission *Its* NODC Gen. Ser. Publ. G-3
Available from Natl. Oceanog. Data Center, Washington, D.C.: $5.00

The following observations and data are presented from this multiple-vessel oceanographic survey: "Description of Participating Ships and Their Programs"; "Oceanographic Station Data"; "Meteorological Data"; "Biological Data"; "Miscellaneous Data and Information"; and "Appendix"—containing instructions for the use of the gathered data in establishing standards for the various disciplines.
G.G.

N65-11664# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AURORA POLARIS AND RADIATION OF THE NIGHT SKY
V. I. Krasovskiy *In its* New Achievements in Study of the Cosmos 9 Mar. 1964 p 43–48 (See N65-11660 02-30)

The results of several years of investigation into the aurora polaris are reviewed. Various conjectures and the evidence concerning different mechanisms causing the glows are discussed. It is emphasized that the aurora is excited by electrons with energies of about 10 keV or by protons with small energies.
D.E.W.

N65-11791# Columbia U., Palisades, N.Y. Lamont Geological Observatory
RESEARCH DIRECTED TOWARD THE USE OF LONG AND INTERMEDIATE PERIOD SEISMIC WAVES FOR THE IDENTIFICATION OF SEISMIC SOURCES Final Report, Aug. 1960–Jul. 1964
L. E. Alsop 31 Jul. 1964 64 p refs
(Contract AF 19(604)-7376; ARPA Order 292; Proj. Vela-Uniform)
(AFCRL-64-835; AD-607946)

Of particular interest to the needs of Project VELA-UNIFORM are the following: a study of the radiation patterns of surface waves from underground nuclear explosions and small magnitude earthquakes; a study of the relative excitation of surface waves by earthquakes and underground explosions; an almost complete summary of Rayleigh wave phase and group velocities for various regions of the world; a program of epicenter relocation carried out so far for the South Pacific Ocean, the Arctic north of 60° N, the Gulf of Aden, the Red Sea, the Arabian Sea, the African Rift Zone, and the Central Indian Ocean; and successful utilization of displacement transducers with long period seismometers.
Author

N65-11809# Massachusetts Inst. of Tech., Cambridge Hydrodynamics Lab.
WAVE INDUCED OSCILLATIONS IN HARBORS: THE EFFECT OF THE VARIATION OF GEOMETRIC PARAMETERS ON THE RESPONSE OF RECTANGULAR HARBORS
A. T. Ippen and Q. N. Fattah Jun. 1964 46 p refs *Its* Hydrodyn. Lab. Rept. No. 70
(Contract Nonr-1841(59))
(R64-22; AD-603971)

This study deals with an additional phase of the response characteristics of a rectangular harbor in relation to waves incident on the restricted opening to the open sea. In particular, the theoretical solution was evaluated and experimental evidence is presented for this response as a function of varying harbor width for a given width of opening and a given length. Thus, in effect, the following three parameters were changed systematically: the aspect ratio of width-to-length ratio of the basin, the ratio of the width of opening to the width of harbor, and the relative position of the entrance of the basin. The last, however, was changed only as a result of changes in the first two ratios, since the position of the entrance remained adjacent to one wall. Whereas the experimental solutions dealt with simultaneous changes in these parameters as a result of changing the width of the basin only, the theoretical treatment presents, generally, solutions for the response characteristics as a function of changes in the aspect ratio and the opening ratio individually.
Author

N65-11824# Air Force Cambridge Research Labs., Bedford, Mass. Optical Physics Lab.
ATMOSPHERIC ATTENUATION MODEL, 1964, IN THE ULTRAVIOLET, VISIBLE, AND INFRARED REGIONS FOR ALTITUDES TO 50 KM Environmental Research Papers No. 48
L. Elterman Sep. 1964 49 p refs
(AFCRL-64-740; AD-607859)

A model of a clear standard atmosphere, for determining attenuation in the ultraviolet, the visible, and the infrared windows, is derived. The derivation is based on a Rayleigh atmosphere combined with aerosol and ozone components. The format of the model is a series of tabulations for 22 wavelengths with Rayleigh, aerosol, and ozone components arrayed at kilometer intervals to an altitude of 50 kilometers. Exploratory calculations pertaining to horizontal, vertical, and slant-path transmission from sea level, transmission between two altitudes, and transmission to space are readily made from the tabulations.
Author

N65-11930# Michigan Technological U., Houghton
ANALYSIS OF IONOSPHERIC DRIFTS UTILIZING DATA OBTAINED WITH CLOSELY SPACED RECEIVERS Final Report
Donald G. Yerg Jun. 1964 378 p refs
(Contract AF 19(604)-8337)
(AFCRL-64-595; AD-607685)

Data obtained at 2.33 Mc/sec and 4.57 Mc/sec with closely spaced receivers were analyzed. The method of derivatives was employed to obtain the average drift velocity vector, the average component of the drift velocity normal to the lines of constant signal intensity, the axial ratio and orientation angle of the pattern ellipse, the root-mean-square departure velocity, the turbulence ratio, the relative area and length scale of the pattern ellipse, and the relative period of signal fading. Daily and seasonal studies are presented for each of these parameters. The observed signal-fading process is shown to be associated with expanding and contracting contours defining irregularities in the signal pattern. The effect of drift is to prevent the signal fluctuations from being controlled by any one irregularity and is otherwise incidental to the fading process. Author

N65-11934# Joint Publications Research Service, Washington, D.C.
CURRENT GEOPHYSICAL RESEARCH IN THE USSR
V. I. Golikov, L. B. Krasil'nikov, G. P. Semenova, and V. S. Aleksandrov 30 Nov. 1964 40 p refs Transl. into ENGLISH of 3 Articles from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 142–159, 168–175
(JPRS-27596; TT-64-51823) OTS: $2.00

The selection of the parameters of the optical system and of the electrophotometer of a device for measuring the microstructure of clouds and fog is discussed. A simplified diagram of the device and an explanation of the small-angle-scattering method used are presented, and calculations are given for each parameter. A paper is presented on the spectral characteristics of materials used in the design of actinometric apparatus. A description is given of an electronic thermoregulator and its operating principle, and also of the thermometric device involved—a radiation detector, such as a bolometer. D.E.W.

N65-11975# Little (Arthur D.) Inc., Cambridge, Mass.
RESEARCH DIRECTED TOWARD THE STUDY OF HEAT TRANSFER IN COMPLEX ROCK SYSTEMS Final Report
A. E. Wechsler and P. E. Glaser Sep. 1964 153 p refs
(Contract AF 19(628)-3279)
(AFCRL-64-738; AD-608509)

This study is part of a program on methods of detection and utilization of lunar water resources. Literature data on the density, thermal conductivity, specific heat, permeability, porosity, thermal diffusivity, and moisture content of rock systems are assembled and tabulated. Experimental data for six typical rocks were obtained and compared to literature data. The apparatus and methods used in the experimental program are described. The results of calculations of the heat and mass transfer associated with extraction of water from subsurface deposits and mined deposits are presented. Specific consideration is given to underground nuclear explosions, "Frasch", fluid bed and kiln processes for water extraction. The results of the analysis indicate that water can be extracted from lunar water resources provided that deposits having approximately 1% water and occurring in significant quantities can be located. The effects of the lunar environment on typical extraction processes are also discussed. Author

N65-11980# Joint Publications Research Service, Washington, D.C.
ACTINOMETRIC ATMOSPHERIC RADIOSONDE MEASUREMENTS OVER THE PACIFIC OCEAN
G. N. Kostyanoy and L. A. Pakhomova 3 Dec. 1964 10 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 11, Nov. 1964 p 29–33
(JPRS-27679; TT-64-51864) OTS: $1.00

The results of actinometric soundings of the atmosphere are presented. The soundings were conducted in the Pacific Ocean area on a research-ship voyage in January–March 1962. The meridional cross section of the distribution of the flux of longwave radiation aloft shows that the real field of longwave radiation differs rather greatly from the mean theoretical field. D.E.W.

N65-11988# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va. Research and Analysis Div.
GENERAL NON-ITERATIVE SOLUTION OF THE INVERSE AND DIRECT GEODETIC PROBLEMS
Emanuel M. Sodano Apr. 1963 29 p refs
(GIMRADA-RN-11; AD-447282)

Improved practical and theoretical formulas are presented for the calculation of geodetic distances, azimuths, and positions on a spheroid. The formulas are designed for use with either electronic computers or desk calculators. For the latter, the formulas lend themselves to the construction of useful interpolation tables. The report includes convenient computation forms and auxiliary equations, which assure a high degree of accuracy for any geodetic line, no matter how short or long (up to half or fully around the earth) and regardless of its orientation or location. Numerical examples of the complete calculation procedure are presented. Author

N65-12015# Naval Research Lab., Washington, D.C. Physical Chemistry Branch
ANALYSIS OF ATMOSPHERIC CONTAMINANTS RECOVERED FROM MA-9 (FAITH VII), PRELIMINARY RESULTS
R. A. Saunders 22 Oct. 1963 5 p refs
(AD-288255)

A chromatogram was made of the charcoal filter contents from the environmental control system of the spacecraft. The relative high content of 101-mg toluene in the desorbate is pointed out and discussed. G.G.

N65-12184# Joint Publications Research Service, Washington, D.C.
THEORY OF MEASUREMENT OF RAINDROP SIZES BY THE ACOUSTIC METHOD
V. V. Mikhaylovskaya 25 Nov. 1964 11 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 157, 1964 p 48–53
(JPRS-27536; TT-64-51785) OTS: $1.00

An acoustic measuring method is presented that utilizes the voltage generated by a drop striking on the surface of a sensor. The value of this charge was found to be proportional to the pressure exerted on the pressure-sensitive element at a certain moment and on the diameter and velocity of the single drop. G.G.

N65-12224# Denver U., Colo.
INFRARED ATMOSPHERIC TRANSMITTANCE AND FLUX MEASUREMENTS Six Month Technical Report No. 8, 1 Jan.–30 Jun. 1964
2 Jul. 1964 17 p ref
(Contract AF 19(604)-7429; ARPA Order 363-62)
(DRI-2168; AD-448953)

Data concerning the transmission of infrared radiation in the earth's atmosphere at high altitudes were obtained by means of a balloonborne spectrometer system capable of recording the infrared solar spectrum at various altitudes up to 31 km. The initial data were obtained by using a small, single pass, prism spectrometer. In order to increase the resolution obtainable, the prism spectrometer was replaced with a grating instrument. Instrumentation changes, spectrometer design, ground tests, and flight program are discussed. D.S.G.

N65-12245# Air Force Cambridge Research Labs., Bedford, Mass.
GEOPHYSICS AND SPACE DATA BULLETIN NUMBER I
Anne L. Carrigan and Norman J. Oliver, ed. Jul. 1964 191 p
(AD-606190)

Data supplied include the following: (1) total field intensity figures from the Component Magnetometer Program at the Weston, Mass. Observatory; (2) cosmic-ray neutron intensity monitor observations from Chicago; Climax, Colorado; Huancayo, Peru; and Mt. Washington, N.H.; (3) oblique backscatter records from the ionospheric sounder at the AFCRL Plum Island Field Site at Newburyport, Mass.; (4) ionospheric absorption curves from riometers at Huancayo; Manila; Maui; New Delhi; São José dos Campos, Brazil; and Thule, Greenland; and (5) information on solar radio emission in the spectral range 50 to 320 Mc/sec recorded at the Radio Astronomy Station of Harvard College Observatory, Fort Davis, Texas.
R.L.K.

N65-12259# Army Map Service, Washington, D.C.
THE PARALLAX OF THE MOON IN TERMS OF A WORLD GEODETIC SYSTEM
Irene Fischer [1963] 41 p refs Presented at the 13th Gen. Assembly of the Intern. Union of Geodesy and Geophys., Berkeley, Calif., Aug. 1963
(AD-602535) OTS: $2.00

The results of four methods of determining the distance of the moon at mean parallax are analyzed and compared. The four methods involve the following: (1) using the meridional transits of the lunar crater Mösting A; (2) using the dynamical theory (where the lunar distance appears as a function of the radius and flattening of the earth, its attraction, and the mass of the moon); (3) using occultations; and (4) using radar. By inserting recent geodetic knowledge (geoid and North America, 30th meridian connection between Europe and South Africa, World Geodetic System) the results are modified and referred to the same reference system in terms of linear units. The numerical factor expressing the perturbation of the lunar orbit due to the sun, consistent with Hansen's lunar theory, is identified.
P.V.E.

N65-12275*# National Aeronautics and Space Administration, Washington, D.C.
RELATIONSHIP OF THE INTEGRAL BRIGHTNESS OF POLAR AURORAE WITH GEOMAGNETIC FIELD VARIATIONS AND SHORT PERIODIC PULSATIONS OF EARTH CURRENTS [O SVYAZI INTEGRAL'NOY YARKOSTI POLYARNYKH SIYANIY S VARIATSIYAMI GEOMAGNITNOGO POLYA I KOROTKOPERIODICHESKIMI KOLEBANIYAMI ZEMNYKH TOKOV]
A. B. Korotin Nov. 1964 8 p refs Transl. into ENGLISH from "IGY Program, Section IV (Aurorae and Airglow)" Moscow, Acad. of Sci. Press, no. 6, 1961 p 33–36
(NASA-TT-F-9219)

Results are compared of auroral brightness measurements made on the Loparskaya station (Institute of Physics of the Atmosphere of the Academy of Sciences of the U.S.S.R.) by means of a photometer with 180° viewing angle, with the variation of horizontal earth magnetic field component, and with the change of the amplitude of short-period pulsations of the earth currents. A clear connection between auroral brightness and earth magnetic field variations is confirmed. The differences between these two phenomena are stated, and an attempt to explain them on the basis of dynamo-theory is made. A connection between auroral brightness and amplitude of short-period pulsations of the earth currents is stated. An attempt to calculate recombination coefficient is made. Author

N65-12324# Joint Publications Research Service, Washington, D.C.
ON DETERMINING THE DENSITY OF ROCK LOCATED CLOSE TO THE DAY SURFACE BY MEANS OF DETAILED GRAVIMETRIC PROSPECTING
V. P. Stepanov 10 Dec. 1964 9 p refs Transl. into ENGLISH from Razvedka i Okhrana Nedr (Moscow), no. 10, Oct. 1964 p 39–42
(JPRS-27769; TT-64-51902) OTS: $1.00

The density of rocks was determined by means of a two-point method of gravimetric observations on the upper and lower points of a terrace. For the compilation of gravimetric maps it is essential to take into account the variable density of the intermediate layer, and to reduce the variable density to the level of the lowest point of the relief (not to sea level). G.G.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-10957# Aberdeen Proving Ground, Md. Human Engineering Labs.
A PRELIMINARY COMPARISON OF RANGE ESTIMATION USING BLACK-AND-WHITE TELEVISION AND THE UNAIDED EYE
Lynn C. Oatman Jan. 1963 14 p refs
(TN-4-63; AD-604986) OTS: $1.00

This investigation compared how accurately target ranges can be estimated from two modes of observation—viewing a black-and-white television monitor and viewing with the unaided eye. For each mode, the subjects made four estimates at each of five distances—100, 300, 600, 800, and 1000 yards. Two conclusions were indicated: (1) Subjects could estimate absolute distance when viewing the TV monitor. (2) There were significant differences between the subjects' constant errors in the two modes.
Author

N65-10961# Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
A HIGH LEVEL GAMMA ALARM FOR CRITICALITY MONITORING
L. H. Cook, Jr. Oct. 1964 16 p refs
(Contract AT(07-2)-1)
(DP-921)

A monitor was developed that detects the gamma radiation from a nuclear accident and gives visible and audible alarms when the radiation exceeds a predetermined level. The instrument also gives a failure alarm when certain common internal malfunctions occur. Auxiliary alarm contacts are available for use with external alarm systems. The instrument is battery powered and, consequently, is unaffected by short-term power outages. A charger maintains the alarm battery at full power.
Author

N65-10986# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio
A PARTIALLY COMPLETED FIXED-GAIN LATERAL-AUGMENTATION SYSTEM FOR THE B-58 AIRCRAFT

Earl L. Stroud (M.S. Thesis) May 1964 46 p refs
(GGC(EE)64-17; AD-603958)

The lateral-system general transfer functions were developed for an aileron-rudder interconnect ratio (ARI) equal to minus one; the effect of high gain in the acceleration loop was qualitatively determined; and the function of the yaw-rate loop was established. The general transfer functions qualitatively indicate that the best location of the accelerometer is at the center of gravity (CG) of the aircraft. A basic concept used in the design of the system was that the problem of pilot coupling during an engine failure will progressively decrease as the damping ratio of the system increases. Preliminary tests of six flight conditions were run on the analog computer, and the damping ratios of the system increased from a range of 0.02 to 0.16 to a range of 0.28 to 0.56. Pilot coupling appears negligible when the damping ratio is greater than 0.36. Author

N65-11004*# Electro-Optical Systems, Inc., Pasadena, Calif.
LIQUID HYDROGEN FILM COOLED PRESSURE TRANSDUCERS
J. Delmonte Dec. 1964 43 p refs
(Contract NAS3-2754)
(NASA-CR-54085; EOS-4270-Final) OTS Prices: HC $2.00/MF $0.50

The first generation construction and test of three cryogenic-cooled combustion pressure transducers capable of transducing steady-state as well as high-frequency pressure pulses have been successfully accomplished. Static tests performed to date indicate that bridge-type solid-state pressure transducers are capable of creditable performance to at least LH_2 temperatures with controllable output (sensitivity) and zero shift. Size adaptability, low weight, good output strength, and electrical simplicity are salient features of this type of pressure instrumentation. Author

N65-11008# Eppley Lab., Inc., Newport, R.I.
REPORT ON THE TEST AND CALIBRATION OF A TIROS III FIVE CHANNEL RADIOMETER
J. J. Roche, A. J. Drummond, and D. T. Hilleary 6 Apr. 1964 53 p refs
(Contract CWB-10075)

The principal subjects discussed are the following: (1) calibration techniques utilizing monochromators to determine the relative spectral response of the various channels, special attention being given to the problems of "stray" radiation present in the monochromator; (2) the selection of optimum sources for employment in these calibrations, due consideration being afforded to energy availability, stability, monochromator-source geometry, detector selectivity with wavelength and the problem of atmospheric absorption in the optical paths; (3) the use of blackbody radiators to establish the integral wavelength sensitivity of the radiometer in the infrared region and also by the use of the long-wavelength cutoff characteristics of selected filters to assess the wavelength response of the radiometer in broad spectral bands to provide a check on results collected by the monochromator method; and (4) the use of an integrating hemisphere to establish the integral wavelength sensitivity of the radiometer in the visible and near infrared regions. Author

N65-11054*# Illinois U., Urbana Coordinated Science Lab.
VACUUM INSTRUMENTATION
D. Alpert et al *In its* Progr. Rept. for Mar., Apr., and May 1964 20 Jul. 1964 p 59-68 (See N65-11051 02-23) OTS Prices: HC $4.00/MF $0.75

The maximum efficiency of ion production, the threshold value for the ion production, and the relationship of sample temperature to ion production were studied for Mo, Pt, and Cu. The equipment is described, and preliminary results are discussed. A technique for electrophoretic deposition of LaB_6 was developed and is described. The photocurrent-suppressor gage performance at lower pressures was improved by changing the suppressor ring geometry. D.E.W.

N65-11074# National Weather Satellite Center, Washington, D.C.
CALIBRATION OF IMAGE DISTORTION IN TIROS WIDE ANGLE PHOTOGRAPHY Meteorological Satellite Laboratory Report
Russell C. Doolittle Jul. 1963 56 p refs
(MSL-15)

The field calibration procedure is outlined. The computation of principal distance and image distortions is described in detail, and results for the wide-angle cameras in TIROS I through VI are summarized. Author

N65-11088# California U., Berkeley Electronics Research Lab.
AN X-BAND INTERFEROMETER
R. E. Pechacek 15 Feb. 1963 26 p refs
(Contract AF 33(657)-7614)
(AF-TDR-64-167; AD-607664)

An interferometer for use in plasma diagnostics is described. A single klystron provides both the transmitter power and the local oscillator signal for a heterodyne receiver. The heterodyne receiver provides a greatly reduced noise figure, and the output signal is independent of the amplitude of the received signal. Author

N65-11101# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION IN THE AREA OF RADIOTECHNICAL MEASUREMENTS Collection of Articles
31 Aug. 1964 127 p refs Transl. into ENGLISH of the Book "Issledovaniya v. Oblasti Radiotekhnicheskikh Izmerenly" Moscow, Gos. Izd. Standartov, 1962 p 1-85
(FTD-MT-64-06; AD-607143)

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12. ON ONE SYSTEMATIC ERROR OF MEASUREMENT OF DIELECTRIC CONSTANT BY THE RESONANCE METHOD WITH THE APPLICATION OF A H_{01n} RESONATOR Ye. B. Zal'tsman and V. Ye. Poyarkova p 119–125 refs (See N65-11113 03-26)

N65-11102# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ELECTRODYNAMIC METER OF CURRENT AND TRANSMITTED POWER IN THE METER AND DECIMETER RANGES OF WAVES

V. R. Lopan' *In its* Invest. in the Area of Radiotech. Meas. 31 Aug. 1964 p 4–15 refs (See N65-11101 02-14)

A vacuum electrodynamic meter was developed that makes it possible to measure current from 6 to 50 mA, at frequencies up to 300 Mc, with an error of less than 2.5%, and to measure transmitted power from 0.2 to 2500 W, at frequencies of 150 to 2000 Mc, with an error of less than 2.5%. Author

N65-11103# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

NEW METHOD OF TEMPERATURE COMPENSATION OF THERMISTOR METERS OF SHF POWER

L. M. Zaks and V. M. Petrov *In its* Invest. in the Area of Radiotech. Meas. 31 Aug. 1964 p 17–26 refs (See N65-11101 02-14)

A new method of regulating the thermocompensation of thermistor power meters is described. The method uses an inertial thermistor as a switch in the feedback circuit of a stabilizer that feeds the measuring bridge. The method makes it possible to accurately adjust the thermocompensation by changing the readings of the power meter. Calculations and experimental results are shown, indicating the possibility of obtaining an instability not exceeding 0.05μW/min. Author

N65-11104# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

GALVANOMETRIC STABILIZERS OF DIRECT VOLTAGE AND CURRENT FOR THERMISTOR METERS OF SHF POWER

Ye. N. Belikov *In its* Invest. in the Area of Radiotech. Meas. 31 Aug. 1964 p 28–35 refs (See N65-11101 02-14)

Small, highly stable, semiconductor, galvanometric voltage- and current-feed stabilizers are described that are used in the measuring circuits of thermistor meters. Their minimum stabilization factor is 100 000. Author

N65-11105# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

EXPERIMENTAL DETERMINATION OF FREQUENCY ERRORS OF DIODE VOLTMETERS IN A RANGE OF FREQUENCIES TO 1,000 MEGACYCLES

A. M. Fedorov and B. Ye. Rabinovich *In its* Invest. in the Area of Radiotech. Meas. 31 Aug. 1964 p 37–47 refs (See N65-11101 02-14)

A method and equipment were developed for separation of the resonance and drift components of the frequency error of electronic voltmeters. For measuring diodes of contemporary design, the Megou formula, with which drift error was calculated until recently, is unsuitable. Therefore, an empirical formula is proposed for determination of drift error, and it is shown that the frequency errors of monotypic diodes are distinguished up to 30%. Author

N65-11106# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ERROR OF COMPENSATIONAL METHOD OF MEASUREMENT OF PULSE VOLTAGE

M. M. Levin *In its* Invest. in the Area of Radiotech. Meas. 31 Aug. 1964 p 48–61 refs (See N65-11101 02-14)

The conditions of compensation of measured voltage are defined, taking into account the exponential form of the volt-ampere characteristic of the diode in the measurement of video pulses and pulses with high-frequency filling. The separate constituting errors of compensation are analyzed, and the limits of application of the compensational method in parts of amplitude and pulse duration are shown. A criterion is proposed for the correct selection of the operation threshold of the indicator part of the voltmeter. Author

N65-11107# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ERROR OF COMPENSATION PULSE VOLTMETERS WITH STATIC AUTOMATIC COMPENSATION

M. M. Levin *In its* Invest. in the Area of Radiotech. Meas. 31 Aug. 1964 p 62–68 refs (See N65-11101 02-14)

The pulse compensation voltmeter with static automatic compensation has an additional error, depending on the minimum value of voltage, for measurement of which the voltmeter is designed. Upon some change of the circuit, this error can be decreased by an increase of the transmission factor in the feedback amplifier; however, here the capacitance of the load necessary for compensation of transient conditions should change, depending upon the measured voltage. Author

N65-11109# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

APPLICATION OF SHORT RADIO PULSES FOR CHECK OF PULSE RESPONSE OF INTERFERENCE METERS

L. A. Pereverzev *In its* Invest. in the Area of Radiotech. Meas. 31 Aug. 1964 p 75–89 refs (See N65-11101 02-14)

Analyzed is the application of short radio pulses for checking the pulse response of interference meters at frequencies above 20 Mc. A method is given for the measurement and checking of the spectral density of a short radio pulse. The longest and least permissible durations of radio pulses are determined. The errors of measurement of pulse response are analyzed, and the results of an experimental check of the proposed method are given. Author

N65-11112# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

FREQUENCY CORRECTION OF THE CAPACITANCE OF A DISK CAPACITOR

A. L. Grokhol'skiy and M. S. Mikiminskiy *In its* Invest. in the Area of Radiotech. Meas. 31 Aug. 1964 p 114–117 refs (See N65-11101 02-14)

Proceeding from formulas for the calculation of a field in a radial line for the case of the simplest wave of type E, the capacitance of a disk capacitor is determined at high frequencies; formulas are derived for the frequency correction of this capacitance up to 200 Mc. Author

N65-11125# Giannini Controls Corp., Durate, Calif.
BRUSHLESS PRECISION POTENTIOMETER Interim Development Report, 5 May–19 Jul. 1964
31 Jul. 1964 18 p
(Contract NObsr-91175)
(ER-8645-1; AD-605528)

Presented are a detailed description of the preparation of cadmium sulphide photoswitches and results of preliminary tests to determine proper sensitizing techniques. Included are preliminary results of tests to determine a correlation between photoconductivity and photosensitive surface gap geometry. Author

N65-11170# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
APPLICATION OF PERCEPTRONS TO PHOTOINTERPRETATION Final Report, 1 Jun. 1963–1 Jul. 1964
T. R. Babcock and G. E. Richmond Jul. 1964 76 p refs
(Contract Nonr-3161(00))
(VE-1446-G-4; AD-605442)

Investigated in particular was the preprocessing of original imagery to take advantage of present state-of-the-art capability in automatic pattern recognition. Major areas of concentration were these: (1) whole-photo classification; (2) object detection; (3) recognition; and (4) system implementation. The following elements were directed toward techniques that would provide early operational utility: (1) property derivation techniques—extraction of properties from photographic segments by optical spatial filters; (2) recognition—design and economical implementation of a recognition system to perform the desired classification; and (3) electro-optical spatial filtering equipment—development of an optical–electronic machine for property extraction for selected photographic segments. P.V.E.

N65-11179# Royal Inst. of Tech., Stockholm (Sweden)
THE GEOMETRICAL QUALITY OF RAYS, RECONSTRUCTED FROM PHOTOGRAPHS
B. Hallert 1964 24 p refs *Its* Trans. No. 219
Available from Henrik Lindstahls Bokhandel i Distribution, Stockholm: 350 KR

An analysis of methods and results of determining the direction of bundles of rays from photographs shows that this can be accomplished with considerably higher geometrical quality by using interpolation principles rather than by using elements of the interior orientation of the camera or photographs. The method of least squares is strongly recommended for computations for camera calibration because well defined information about the geometrical quality and error propagation can be expressed in arbitrary functions of the image coordinates. M.P.G.

N65-11218# IIT Research Inst., Chicago, Ill. Technology Center
STUDY OF FACSIMILE SCANNING AND RECORDING TECHNIQUES EMPLOYING FIBER OPTICS Final Report, 15 Dec. 1961–15 Apr. 1964
O. H. Olson and D. A. Pontarelli 3 Sep. 1964 88 p refs
(Contract DA-36-039-SC-88927)
(IITRI-A1203-28; AD-447095)

An AN/GXC-4 (XC-2) facsimile transmitter has been modified by replacing its conventional optics with fiber optics. Two modifications of the transmitter were made: initially, a fiber optics system capable of scanning 2.5-in. wide copy was employed to test the basic concepts and to improve optical and mechanical techniques; the final equipment incorporated a fiber-optics system capable of scanning 8.5-in.-wide copy continuously. In both instances, recordings were made by a conventional recorder on Polaroid film. Optical and physical properties of coated fibers have been studied and evaluated, and image quality of fiber-optics facsimile reproductions have been optimized. Author

N65-11231# Federal Aviation Agency, Atlantic City, N.J. Evaluation Div.
EVALUATION OF HONEYWELL MODEL 7182 RADAR ALTIMETER Final Report
Edmund A. Zyzys Jun. 1964 68 p refs
(RD-64-95)

The altimeter, a tracking-pulse radar, employed a leading-edge tracker to develop dc voltages analogous to altitude and altitude rate. The evaluation included both flight tests and laboratory tests. Altitude and altitude-rate accuracies were determined from 186 data runs over runway terrain and water. Phototheodolites and ground elevation surveys were used to determine aircraft altitude-above-terrain. Altitude-rate data were obtained from phototheodolite space-position and time data. Altimeter outputs were recorded on an airborne oscillograph and correlated in time with phototheodolite data. Altimeter performance was also checked over approach lights, grass, trees, dirt, and buildings. Author

N65-11236# Martin Co., Orlando, Fla. Physical Sciences Research Lab.
CHARGED PARTICLE ACCELEROMETER First Quarterly Report, 1 Jun.–31 Aug. 1964
O. R. Kyler, F. F. Schloetzer, and C. B. Strang Sep. 1964 57 p refs
(Contract NOw 64-0453-C)
(OR-6171; AD-447945)

A charged-particle accelerometer capable of sensing both linear and angular accelerations is being studied. The effort to date consisted of studies of suspension parameters and characteristics applicable to charged-particle accelerometers, studies of pickoff systems, evaluation of materials for particles and electrodes, and investigations of force-balance loops. Author

N65-11256# Naval Research Lab., Washington, D.C.
THE ANALYSIS OF VARIABLE RELUCTANCE TRANSDUCERS: THE CLASSICAL METHOD
R. M. Moore 25 Aug. 1964 33 p ref
(NRL-6088; AD-605547) OTS: $0.75

The operating equations of a variable reluctance transducer are derived in this report through the application of classical electromagnetic theory. These equations are formulated in terms of inductance and a quantity called the electrical force factor. The basic equations are shown to be nonlinear, and a set of approximate linear equations is derived for a special class of inputs. Author

N65-11317# General Electric Co., Syracuse, N.Y. Military Communications Dept.
MATRIX CONTROLLED DISPLAY DEVICE Final Development Report, 1 Jul. 1963–1 Aug. 1964

1 Aug. 1964 48 p
(Contract NObsr-89334)
(AD-603545)

This report describes the results of a program to develop a matrix-controlled display using in-air surface deformation recording and TIRP (total internal reflection prism) projection techniques. An experimental model providing a 32 × 32 elemental portion of the large screen display was constructed. Surface deformable media of thermoplastic and oil were investigated. Matrix electrode fabrication by evaporation and etching techniques was established. Different electrode spacings and widths were evaluated to determine the cell dimensions for an optimum display. Several thermoplastics and heat development methods were investigated to insure fast update times. Author

N65-11342# Atomics International, Canoga Park, Calif.
AN ONLINE REACTIVITY METER FOR THE SRE
M. R. Pellet 15 Oct. 1964 23 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10186) OTS: $0.50

At the SRE, the excess reactivity is used as a continuous monitor of core normalcy during operation. To provide an immediate indication of abnormalcy, an online reactivity meter was developed. The meter consists of an analog circuit that continuously computes the reactivity changes due to temperature, power, and xenon effects. Author

N65-11352# Massachusetts Inst. of Tech., Cambridge Electronic Systems Lab.
HIGH-PRECISION PRESSURE SENSOR Fifteenth Quarterly Progress Report, 8 May–7 Aug. 1964
Lewis G. Anderson and Edward J. Mc Kay, Jr. Aug. 1964 20 p
(Contract NOw-61-0400)
(ESL-QR-213; DSR-8684; AD-447948)

This report summarizes progress on the development of a zero- to 2500-psi pressure sensor, having an overall precision of 1/4 psi. Present work concerns development of a practical instrument based on a velocity of sound technique whose feasibility was demonstrated in earlier work. The current status of the work is outlined, problems are identified, and solutions to date are described. The advantages and limitations of sound-velocity pressure sensing are described. The electronic circuit is documented, and test results obtained with the laboratory model equipment are presented. Transducer work and long-term stability studies now in progress are described. Author

N65-11362# Bendix Corp., Ann Arbor, Mich. Systems Div.
APPLICATION OF A PHOTOMETRIC TECHNIQUE FOR MAPPING THE LUNAR SURFACE
M. E. Amdursky Oct. 1964 30 p refs Presented at the 3d Symp. on Remote Sensing of Environment, Michigan U., 14–16 Oct. 1964

The program for landing men on the lunar surface requires that suitable and safe sites be defined and verified before the actual landings. This may be accomplished in part by remote sensing from orbiters and from surface stationary or roving platforms. The studies discussed have been performed to gain knowledge on how the lunar landscape might appear to an image-forming device such as a television camera and display system, and how the unique back-scattering lunar photometric function may be utilized to aid in determining the existence and nature of slopes and other lunar features. A simulated lunar model that exhibits the photometric characteristics and an analysis of the accuracies achievable are described. Means by which a computer can be used to analyze the video data are suggested. Author

N65-11401*# Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.
LUNAR IMPACT TV CAMERA (RANGER III, IV, V) Final Engineering Report, Mar. 25, 1960–Nov. 1, 1961
15 Nov. 1963 67 p
(Contract JPL-M-48068)
(NASA-CR-59579; AED-R-2076) OTS Prices: HC $3.00/MF $0.75

The lunar impact TV camera, designed to take and transmit a series of detailed pictures of the surface of the moon during the descent of the spacecraft to the moon, was limited to a read-out time of 10 seconds per picture with horizontal and vertical resolution requirements of 200 lines each, due to the 2-kc bandwidth restriction. Other limitations were imposed upon the design of the camera by the maximum weight and power permitted, the optical systems available, the anticipated light levels, and the environmental requirements. Design of the image sensor was performed within these limitations and necessitated significant advances in the state-of-the-art for slow-scan TV camera systems in three areas: (1) rapid-erase techniques, (2) dark-current compensation, and (3) the use of a subcarrier frequency video signal to improve video amplifier capabilities. The final image sensor configuration comprised an electrostatically deflected and focused vidicon containing a special slow-scan photoconductor storage surface with rapid-erase capabilities. Author

N65-11457 Aeronautical Research Council (Gt. Brit.)
A MICROSECOND RESPONSE PRESSURE TRANSDUCER FOR BLAST WAVE MEASUREMENTS
D. Pierce London, HMSO, 1964 16 p refs Supersedes RAE-TN-AERO-2935, ARC-25819
(ARC-CP-747; RAE-TN-AERO-2935; ARC-25819) HMSO: 3s 6d

The development is described of a pressure transducer that makes it possible to measure the pressure on the surface of a wind-tunnel model during the first 30μsec following the passage of a blast wave. This has necessitated the elimination of 'ringing' of a piezoelectric transducer over a period during which it normally occurs. Experiments to develop a transducer for the millisecond range were limited in number, but the most promising design of those tested is also described. Author

N65-11480# Texas U., Austin Defense Research Lab.
A STUDY OF THE EFFECT OF FLOATING-ELEMENT MISALIGNMENT ON SKIN-FRICTION-BALANCE ACCURACY
Francis B. O'Donnell, Jr. 3 Mar. 1964 47 p refs
(Contract NOrd-16498)
(DRL-515; CR-10; AD-602891)

An experimental investigation was made of the effect of operating a floating-element-type skin-friction balance with the element misalined in the test surface. The misalinement consisted of mounting the element parallel to the test surface but recessed below or projecting above the surface. A drive mechanism was constructed that permitted traversing the balance and its element through a range of approximately 0.003-in. of recess to 0.003-in. of projection. The effect of misalinement on balance output was determined in a continuous-flow wind tunnel over a Mach number range of 1.70 to 3.55, at several Reynolds numbers. The results indicated that any degree of misalinement resulted in a change of

balance output. This error in output was slightly larger for the case of a projecting element than for the recessed-element case. No consistent correlation between misalinement error and either Mach number or Reynolds number was found. Author

N65-11489# Chicago U., Ill.
EVALUATION OF ERRORS IN THE GRAPHICAL RECTIFICATION OF SATELLITE PHOTOGRAPHS
Tetsuya Fujita [1963] 14 p refs
(Grant Cwb-WBG-6)
(SMRP-30; AD-603574)

In order to investigate the proper design of the grid systems used in gridding or rectifying satellite pictures, an evaluation of errors from various sources was made. It was found that the discrete grid intervals of both height and tilt are of vital importance in determining final accuracy. The rotation of the grid around the exposure subpoint is found to be permissible unless an accuracy of 0.1° is required. Where accuracy requirements permit, OEC height grids may be replaced by ZE height grids, which are less complicated and much easier to use. This change also permits the use of perspective height and tilt grids with less than 0.2° error. An evaluation of the gridding error due to the uncertainty of the spin-axis points revealed that it may be almost entirely eliminated by adopting a coupled rotation of the principal lines. Author

N65-11572# Mound Lab., Miamisburg, Ohio
DETERMINATION OF COINCIDENCE CORRECTIONS IN A PROPORTIONAL COUNTER: I DOUBLE SOURCE METHODS
I. W. Kirby 7 Nov. 1964 19 p refs
(Contract AT(33-1)-GEN-5)
(MLM-1197) OTS: $1.00

This is the first of a series of reports critically examining various published methods for determining the resolution time of a counting system, with specific reference to precise alpha counting in a proportional counter. The multiple-source method is compared with the simple double-source method and is found to offer no practical advantage and to introduce some serious disadvantages. An exact solution is derived for the double-source method, which eliminates the computational error inherent in the usual approximation employed for determining the resolution time. Author

N65-11677# Joint Publications Research Service, Washington, D.C.
SEMICONDUCTOR LIGHTNING STROKE RECORDERS
P. S. Lydzar 25 Nov. 1964 9 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 157, 1964 p 54–58
(JPRS-27532; TT-64-51781) OTS: $1.00

This article describes the circuit of a semiconductor lightning stroke recorder designed for signaling thunderstorm activity in a certain area in the vicinity of the observation point. In addition, the article describes a modification of this instrument, designed for recording the number of atmospherics exceeding a particular level in amplitude. Author

N65-11788# American Science and Engineering, Inc., Cambridge, Mass.
ANALYSIS OF PERFORMANCE OF A ROCKET-BORNE RETARDING POTENTIAL ANALYZER Final Report
Oscar P. Manley May 1964 41 p refs
(Contract AF 19(604)-8849)
(ASE-608; AFCRL-64-796; AD-607761)

The use of a rocketborne retarding potential analyzer (RPA) for determining positive ion densities in the ionosphere is studied. At the altitudes of interest (40 to 90 km) shock ionization induced by the nose cone may exceed ambient ionization. Moreover, the positive ion current measured by means of the RPA is not linearly dependent on the ion density. Author

N65-11802# Bendix Corp., South Bend, Ind. Analytical Mechanics Dept.
BAND-PASS SHOCK ABSORBER STUDIES
R. M. Palmer et al Apr. 1964 138 p refs
(Contract NOw-60-0373-c)
(SH-64-1; AD-603749)

The principal objective of this program was to study the application of the band-pass principle to aircraft landing-gear shock struts. The program included both theoretical and experimental evaluation. The experimental program consisted of the fabrication of a band-pass unit and the modification of the A3J-1 shock strut to utilize it and the test program conducted in the drop test tower over the 120-inch dynamometer. The principal conclusion coming from the program is that loads arising from arresting-cable impact into the unsprung mass (tire, wheel, axle, and inner cylinder of shock strut) are not alleviated to any appreciable degree through use of the band-pass principle. The incremental increases in loads through the landing-gear attach points into the aircraft structure, however, may be reduced up to 50%. Author

N65-11877# Ewen Knight Corp., East Natick, Mass.
MOLECULAR ATMOSPHERIC OXYGEN HORIZON STUDY. DESIGN OF A PROTOTYPE RADIOMETER Scientific Report No. 2
A. L. Lilley and F. R. Zatlin 22 Jun. 1964 42 p
(Contract AF 19(628)-3239)
(AFCRL-64-527; AD-607899)

The report constitutes a two-fold summary of theoretical analysis and systems design for the purpose of utilizing the 60-Gc radiation characteristics of atmospheric oxygen for horizon definition purposes and related measurements. The results of the theoretical analysis are specific and depend directly upon the Van Vleck–Weisskopf theory and the assumed ARDC model atmosphere. The departure of the predicted horizon effects from the actual properties of the horizon will depend primarily upon the validity of the ARDC model atmosphere. The results of the radiometric system design may be divided into two categories: subsystems that are independent of the carrier vehicle and subsystems that interface with the carrier vehicle. The system designs are supported by laboratory test data. Author

N65-11929# Applied Psychology Corp., Arlington, Va.
PERFORMANCE OF PHOTOGRAPHIC INTERPRETERS AS A FUNCTION OF TIME AND IMAGE CHARACTERISTICS Final Report
Louis G. Porter et al Griffiss AFB, N.Y., RADC, Sep. 1964 100 p ref
(Contract AF 30(602)-2717)
(RADC-TDR-63-313; AD-608219)

Effects on photo interpreter performance of different viewing times, work-rest cycles, and image quality and content were studied. Results indicate that collection and processing agencies should avoid inadequate levels of scale, resolution, or contrast even at the expense of sacrificing high levels of any of these variables. Viewing times of 4 seconds for scanning and 60 seconds for identifying features seem adequate. In these times, the interpreter has extracted about 90% of the total information he is going to extract. Over relatively short

periods of time (4 hours), varying work-rest cycles do not significantly affect accuracy or thoroughness of interpreters. Author

N65-11957# Texas Instruments, Inc., Dallas, Tex. Science Services Div.
OCEAN-BOTTOM SEISMOMETER DATA COLLECTION AND ANALYSIS Final Report
Patrick J. Farrell 12 Oct. 1964 113 p refs
(Contract AF 19(604)-8368; ARPA Order 292-62; Proj. Vela-Uniform)
(AFCRL-64-666; AD-607785)

Ocean-bottom data from three independent geographical locations in the Pacific Ocean were studied for consideration of means of detecting and identifying of underground or underwater nuclear explosions. Signal-to-noise ratios on the ocean bottom are generally inferior to those at a land control station by 0 to −10 dB in two of the three areas. The superior ocean-bottom (S/N) ratios in the Hawaii area are due principally to a "noisy" land site. The study reveals no consistent differences in phase development between the ocean bottom and land other than effects associated with the free surface and the late arriving T-phase. For near regional and local events, the ocean-bottom seismogram often shows greater high-frequency energy content than that of a land site. Ocean-bottom magnification of signal energy by as much as 20 dB is consistently observed for teleseisms and occasionally for near-regional and local events. Ambient noise levels on the ocean bottom are greater than at a land control station by about 20 dB at the low frequencies in all three areas. The difference decreases with increasing frequency. Author

N65-12011# Osservatorio Astrofisico di Arcetri, Florence (Italy)
EBERT-CASSEGRAIN SPECTROGRAPH FOR SOLAR WORK. RECORDING OF THE SOLAR SPECTRUM BETWEEN 4000 Å AND 5000 Å Final Report
M. Rigutti and R. Falciani 31 Jul. 1964 46 p ref
(Contract AF 61(514)-1050)
(AFCRL-64-752; AD-449656)

A solar spectrograph is described in detail. The new instrument, called Ebert–Cassegrain because of its particular mounting, has a focal length of 8000 mm with a real total length of 2900 mm and is equipped both photographically and photoelectrically. At present it is being used to set up an atlas of the solar spectrum between λ 4000 Å and λ 5000 Å. The atlas is divided into two sections: the reproductions of the photographic plates and of the microphotograms obtained from the same plates. Author

N65-12018*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYSIS OF CLOSED CIRCUIT TELEVISION AND FIBER OPTICS FOR REMOTE VISUAL CONTROL OF TIG WELDING
W. A. Wall and L. K. Swaim 17 Sep. 1964 32 p
(NASA-TM-X-53131) OTS Prices: HC $2.00/MF $0.50

Two weld-viewing systems, closed-circuit television and stereo fiber optics, were tested for their relative abilities to transmit weld-quality information to the weld operator. These tests were arranged to gather statistical data for comparing the information transmission merits of the two systems. One goal of the project was to determine if the validity of this method of analysis could be established. Data reduction supported the postulation that definite trends could be denoted using this test approach, and results support the belief that both fiber optics and closed-circuit television pictures are suitable for remote aluminum welding control. Author

N65-12019*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EVALUATION OF HIGH ACCURACY PRODUCTS CORPORATION MODEL PC-202 AUTOMATIC PARTICLE COUNTER
J. O. Romine and J. B. Gayle 2 Oct. 1964 22 p refs
(NASA-TM-X-53145) OTS Prices: HC $1.00/MF $0.50

The HIAC Model 202 Automatic Particle Counter gives results that appear to be generally equivalent to those obtained microscopically. The reproducibility of particle counts for replicate samples taken from a well-regulated system approaches the values predicted theoretically by means of the Poisson equation. Therefore, the theoretical values reflect the inherent variability of the test results and constitute the lower limit for determined values. Author

N65-12105# Massachusetts Inst. of Tech., Cambridge Ionization Research Lab.
DESIGN OF A QUADRUPOLE MASS SPECTROMETER
C. E. Woodward and C. K. Crawford Jan. 1963 36 p refs
(Contracts AF 33(616)-8353; Nonr-1841(10))
(TR-176; AD-297488)

A mass spectrometer using an electric-quadrupole mass filter has been designed and built to cover 1 to 400 amu in four ranges. The rf drive voltages for the quadrupole filter are obtained from a class-C amplifier with feedback-controlled modulation. The dc voltages are obtained from feedback-controlled amplifiers. Provisions are made for rapidly sweeping the mass range by changing the rf and dc voltages and for oscillographic presentation of the spectra. The spectrometer is found to have a maximum resolution of about 700; maximum resolution at unity transmission is about 30. The lowest pressure it can detect at present is about 10^{-10} torr. There is a fine structure on the peaks of the mass spectrum that is dependent upon the transverse momentum of the ions entering the quadrupole. Author

N65-12123# Block Associates Inc., Cambridge, Mass.
FIELD CALORIMETRY/IR INSTRUMENTATION Quarterly Technical Report, 16 Jun.–16 Sep. 1964
A. L. Lavery, R. K. Lager, Jr., and A. S. Zachor 30 Sep. 1964 46 p refs
(Contract DA-18-035-AMC-262(A); ARPA Order-535)
(QTR-1; AD-448102)

Experimental techniques and instrumentation systems are described for the measurements of the radiative energy released by chemical reactions that are suitable for "Heat Flux" weapon systems, and for the calculations of the spectral distribution of this energy as a function of time. Photographic, radiometric, and spectral data are gathered simultaneously to obtain the spectral distribution of the radiation, the total radiated power, the energy radiated prior to a given time instant, the effective temperature, and the spectral emissivity. G.S.

N65-12139# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
ON THE THEORY OF LINEARITY OF HOT-CATHODE IONIZATION GAUGE
C. Y. Hwa 27 Oct. 1964 20 p refs Transl. into ENGLISH from Wu-li Hsueh Pao (Peking), v. 19, no. 2, 1963 p 73–82
(RSIC-320; AD-608370)

The characteristic equation of a hot-cathode ionization gage is derived from the theory of Townsend discharge, with the form $i_+/i_e = 1 - e^{-(k_1 p - k_2 p^2)}$ where i_+ is the ion current, i_e is the electron current, p is the gage pressure, and both k_1 and k_2 are constants. Only at $i_+ << i_e$, the equation shown above becomes $i_+/i_e = \Gamma_p$, where Γ is the sensitivity of gage and approximately equals k_1. The critical pressure, at which linearity between i_+ and p breaks down, is $p_c = 0.02/\Gamma$, and the permissible error of the gage calibrated is 1%. Author

N65-12141# Argonne National Lab., Ill. Chemistry Div.
A MULTIPURPOSE NEUTRON DIFFRACTOMETER
Masao Atoji Jul. 1964 120 p refs
(Contract W-31-109-ENG-38)
(ANL-6920) OTS: $4.00

An automatic double-crystal neutron diffractometer, designed for both crystal- and magnetic-structure analyses at temperatures from 2° K to approximately 2000° K, and with a magnetic field of up to 18 kG for a 1.4-in. gap, was constructed. Besides outlining construction and instrumentation of the neutron diffractometer and its auxiliary equipment, this report includes a critical evaluation of the unit, the experimental results representing the instrumental characteristics, and tables, diagrams, and formulas that would be useful in practical neutron studies. A list of selected reference books and review articles is given. D.E.W.

N65-12152# Massachusetts Inst. of Tech., Cambridge
SEISMIC ARRAYS FOR THE DETECTION OF NUCLEAR EXPLOSIONS Scientific Report No. 8
Enders A. Robinson 30 Jun. 1964 104 p refs
(Contract AF 19(604)-7378; ARPA Order 180-61; Proj. Vela-Uniform)
(AFCRL-64-855; AD-608275)

Seismic arrays are multichannel sensor patterns immersed in a multidimensional signal–noise field, and the analytic problem is analogous to that of radar antennas. A review of antenna theory considers questions of aperture width, antenna resolution, and of optimum design criteria; a review of spectral theory includes special examination of the Ross "time gates." The general optimization problem for multichannel data leads to large systems of normal equations of Toeplitz form (as presented in previous reports), which require recursion solution techniques to be computationally feasible. Such techniques are elaborated in terms of polynomials orthogonal on the unit circle. The specific seismic array problem is then considered in terms of plane-wave-front signal and noise contributions plus incoherent noise, and details of the "velocity filtering" method are presented. Author

N65-12201*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A REVIEW OF PHOTOGRAPHY OF THE EARTH FROM SOUNDING ROCKETS AND SATELLITES
Paul D. Lowman, Jr. Washington, NASA, Dec. 1964 26 p refs
(NASA-TN-D-1868) OTS Prices: HC $0.75/MF $0.50

This paper reviews the methods and recent results of hyperaltitude photography, or space photography (pictures taken from space), of the earth, and discusses the potential applications and problems of space photography. Stress is placed on pictures of the earth's surface rather than cloud cover. Numerous pictures have been taken from sounding rockets, chiefly Vikings and Aerobees. These photographs include a large number of infrared pictures, taken on 4- × 5-inch film with a 25A filter, which are among the most useful for terrain analysis. In those infrared pictures taken from altitudes of 65 to 158 miles the average scale ranges from 1:820 000 to 1:1 700 000 and the useful coverage per photograph from 2700 to 43 000 square miles. Several score color pictures have been taken on Mercury flights with 35-mm and 70-mm cameras. The areas photographed include northern and central Africa, Florida, the Bahamas, the Middle East, and southern Asia. Author

N65-12212*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COPPER-WIRE-CARD DETECTORS
Luc Secretan *In* NASA. Langley Res. Center Micrometeoroid Satellite Explorer XIII (1961 Chi) Nov. 1964 p 167–170 (See N65-12203 02-31) OTS Prices: HC $3.50/MF $1.25

Each copper-wire-card detector consisted of a winding of fine wire (2-mil and 3-mil) mounted to a 1.45- by 7.00-in. rectangular card. The total effective area was about 1.2 ft^2. The particle size required to break a wire was estimated to be one-half the size of the wire. Based on current estimates of the meteoroid influx rate, the required time for one break would be 24 days for the 2-mil wire cards and 120 days for the 3-mil cards. No hits were recorded during exposure to the space environment in the 2 1/2 day life of Explorer XIII. R.L.K.

N65-12213*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CADMIUM-SULFIDE EXPERIMENT
Luc Secretan *In* NASA. Langley Res. Center Micrometeoroid Satellite Explorer XIII (1961 Chi) Nov. 1964 p 171–173 (See N65-12203 02-31) OTS Prices: HC $3.50/MF $1.25

The cadmium-sulfide sensors were designed to detect micrometeoroid particles too fine to damage heavy metallic hardware. On Explorer XIII the useful area was 3.1 $in.^2$. The construction was that of a mirrorized ellipsoidal flask; this geometrical body had two optical foci, so that a ray emanating from one focus would be concentrated at the second focus by the reflecting walls. To realize these conditions, the aluminized Mylar film was stretched in one of the focal planes, and the cadmium-sulfide cell was mounted in the other. Should a micrometeoroid penetrate the opaque aluminized film, the rays from the sun would fall on the cell or be reflected on it from the mirrorized walls. The sensitivity of the cells was such that a particle about 1 mil in diameter could be detected. It was estimated that one hit by a particle this size would occur in about 20 days. However, the Mylar film ruptured during launch, probably due to improper flask venting, and the large amount of sunlight admitted made the experiment inoperative. R.L.K.

N65-12214*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
IMPACT-DETECTION EXPERIMENT
Alfred G. Beswick *In its* Micrometeoroid Satellite Explorer XIII (1961 Chi) Nov. 1964 p 175–198 ref (See N65-12203 02-31) OTS Prices: HC $3.50/MF $1.25

A meteoroid-particle impact-detection experiment was included as a secondary experiment of the Explorer XIII satellite in order to extend micrometeoroid measurements to a low population range where few data exist, and to augment data amassed previously. Impact detectors having 0.01, 0.1, and 1.0 g-cm/sec threshold levels of momentum sensitivity were used. One configuration was a pair of stainless-steel plates, with an area of 0.142 m^2, mounted on the conical portion of the satellite forward shell and used for the high- and low-sensitivity impact detection. The twenty 0.005-in.-thick pressurized-cell penetration detectors were also sensitized for impact detection and were used for intermediate-sensitivity impact detection. Experimental results indicated measured flux rates substantially higher than those measured by similar satellite experiments, although these rates decreased with time in orbit. No explanation is known for this circumstance, although it is possible that the low perigee orbit of Explorer XIII could have been a factor in producing the high counting rates. R.L.K.

N65-12264# Edgerton, Germeshausen and Grier, Inc., Boston, Mass.
VELA SIERRA VT/4060/ASD(59) Third Quarterly Report, 1 Feb.–30 Apr. 1964

L. B. Woolaver 31 Jul. 1964 70 p
(Contract AF 33(657)-12291; ARPA Order-159)
(B-2816; AD-447311)

Construction of the direct-view optical system is described. It employs silicon solar-cell panels as the detector element, and it operates on a constant root-mean-square noise principle. The triggering is achieved on a signal that exceeds the present, but variable, threshold level of the system. Since the number of detectors in this system can exceed the number of record and display units, an automatic routing of the video signal to the proper record and display subsystem must be accomplished. An evaluation study confirmed that the properties of four photovoltaic cell arrays met the design goals. R.L.K.

N65-12281# Royal Aircraft Establishment, Farnborough (Gt. Brit.)
A COMBINED OSCILLATOR, INDUCTANCE BRIDGE, AND DEMODULATOR FOR USE WITH PUSH-PULL INDUCTANCE TRANSDUCERS
P. E. Burry London, Min. of Aviation, Jun. 1964 25 p refs
(RAE-TN-IR-43)

A combined oscillator, inductance bridge, and demodulator unit is described that enables a direct voltage output to be obtained from a push–pull variable-inductance transducer. The unit, which requires a dc supply, has a low output impedance. Test results given show the linearity of the unit when combined with a transducer, and the effects of temperature and supply voltage variation on the output. Author

N65-12332# Weapons Research Establishment (Australia)
DESIGN AND TEST SPECIFICATION FOR THE TIM CLOCK UNIT
M. C. Payten and A. M. Goodway Jul. 1964 33 p refs
(WRE-TN-EC-6)

Detailed are the electrical and mechanical characteristics of the TIM clock. The clock operates from pulses emitted by the TIM search unit and provides, in digital form, a visual display of hours, minutes, and seconds encoded in a TIM timing code. The coded signals are initially recorded on magnetic tape and played back via the TIM search unit. R.L.K.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-10989# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
GASKET FAILURES IN PLUTONIUM REDUCTION FURNACES
W. V. Conner 28 Oct. 1964 34 p refs
(Contract AT(29-1)-1106)
(REP-435) OTS: $0.50

An investigation was made to determine the cause of a sharp increase in the number of failures of the gasket used to obtain a seal between the pressure vessel and the block valve in plutonium reduction furnaces. No correlation was found between the gasket failures and several items, such as variations in the chemical composition of the reduction charge, operator mixing techniques, or the water content of the argon used for purging the reaction vessel. It appeared that a leak in the block valve or gasket, and/or improper purging of the reaction vessel, caused the molten slag to splatter onto the gasket and dissolve a portion of it. R.L.K.

N65-11122# Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
ATTACHING FUEL ASSEMBLY RIB SPACERS BY ELECTRON BEAM WELDING
Lawrence J. Scott Jun. 1964 46 p refs
(Contract AT(07-2)-1)
(DP-889) OTS: $2.00

Methods were developed for attaching rib-shaped spacers to nuclear fuel elements and housings by means of electron-beam welding. Zircaloy ribs of various sizes were welded to the outside of tubes containing metallic uranium fuel. Also, ribs were attached to the inside and outside of thin-wall Zircaloy tubes to form fuel element housings. Weld quality was judged by examining weld sections and by conducting corrosion and mechanical property tests. Full-size ribbed housings were charged to the heavy-water-components test reactor. Author

N65-11165# Texaco Corp., Beacon, N.Y.
RESEARCH ON THERMAL EFFECTS ON FUELS ATTRIBUTABLE TO STORAGE Technical Documentary Report, May 1963–Apr. 1964
J. J. Bialy, T. A. Norris, and F. P. Frascati Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jul. 1964 47 p
(Contract AF 33(657)-10746)
(APL-TDR-64-83; AD-606570)

The research coker was modified to a more dynamic system, both to approach the test conditions used in various fuel test rigs, and to simulate actual mission profiles for different supersonic aircraft. The modifications included vacuum system for the fuel reservoir, cold finger device, and sampling port for fuel sampling. A series of shakedown runs have been completed using the modified test aggregate. The analytical phase of the program entailed development of sampling method and determination of dissolved oxygen and nitrogen gases in fuel at the ppm range. Author

N65-11202# Mechanical Technology, Inc., Latham, N.Y.
EXPERIMENTAL INVESTIGATION OF A STEAM LUBRICATED JOURNAL BEARING Interim Progress Report
J. S. Meacher 1 Aug. 1964 37 p refs
(Contract Nonr-3731(00))
(MTI-64TR40; AD-605503)

Apparatus and preliminary testing for the experimental investigation of a steam-lubricated journal bearing are described. The test bearing is an externally pressurized, double-row, orifice compensated type, 3.0 inches in diameter and 3.0 inches in length. This work is a continuation of a study of process fluid lubrication wherein the performance of a steam-lubricated thrust bearing has previously been investigated and reported. The work is directed toward the development of process-fluid-lubricated bearings for shipboard application. Steam was therefore considered to be the lubricant fluid with most potential for practical application. The choice of an externally pressurized test bearing, rather than hydrodynamic type, was based on the load capacity requirements of probable shipboard applications. Preliminary tests were conducted at room temperature and at 400° F using nitrogen instead of steam as lubricant. A baseline of bearing performance was thus established for comparison with future performance with steam at various conditions. Author

N65-11206# Florida State U., Tallahassee
THE DISTRIBUTION OF WAITING TIME IN A MACHINE INTERFERENCE PROBLEM. THE DEVELOPMENT OF STATISTICAL METHODS FOR QUALITY CONTROL AND SURVEILLANCE TESTING
Vincent Hodgson May 1964 15 p refs
(Contract Nonr-988(08))
(ONR-TR-12; AD-605555) OTS: $1.00

This paper considers the probabilistic behavior of a system consisting of one man who repairs a set of m machines one at a time in the order in which they break down. The usual assumption of exponentially distributed working time for each machine is made. Interest centers on the distribution of the length of time a machine is broken down between its working times. Methods and results are a little simpler than those of Takács. In particular, a new expression is found for the probability density function of waiting time in the case of exponentially distributed repair times. Author

N65-11216# Naval Ordnance Lab., White Oak, Md.
SAFETY PRINCIPLES FOR LABORATORY AND PILOT-PLANT OPERATIONS WITH EXPLOSIVES, PYROTECHNICS, AND PROPELLANTS
1 Jul. 1964 145 p refs
(NAVWEPS-OP-3237; AD-446737)

A manual for personnel associated with the research, development, and pilot-plant manufacture of explosive, pyrotechnic, and propellant materials is presented. The importance of safety programs and the necessity of adhering to them are emphasized. The nature of the hazardous conditions and the precautions that must be taken to avoid them are explained. M.P.G.

N65-11300# Du Pont de Nemours (E.I.) and Co., Wilmington, Del. Pigments Dept.
HIGH TEMPERATURE THERMOELECTRIC GENERATOR Quarterly Report, Period Ending Mar. 31, 1964
W. T. Hicks [1964] 5 p
(Contract NObs-88639)
(AD-604736)

The construction of the modules for the 300-watt thermoelectric generator has been standardized except for the air seal on the cold end of the modules. The segmented positive leg of the modules consists of a copper heat sink, followed by a sodium-doped lead telluride cylinder, and terminated by a tantalum-doped tungsten diselenide cylinder. The negative leg consists of a gold–nickel alloy strap running along one side to the hot end of the positive leg. The assembly is encapsulated in a closed-end mullite tube. Both the main seal between the mullite capsule and the copper foot of the modules, and the seal around the lead-in for the negative strap are still under development. Drawings showing the final construction of the generator have been completed. It appears that forced-draft cooling will be necessary to achieve reasonable compactness. M.P.G.

N65-11318# Joint Publications Research Service, Washington, D.C.
DIFFUSION BRAZING OF NONFERROUS METALS AND ITS POSSIBILITIES
N. F. Lashko and S. V. Lashko 23 Nov. 1964 11 p refs Transl. into ENGLISH from Tsvetn. Metal. (Moscow), no. 8, p 86–90
(JPRS-27502; TT-64-51751) OTS: $1.00

The general process of diffusion brazing, a variety of capillary brazing in which the brazed seam hardens from the liquid state without cooling while keeping the solder at a higher temperature than that of the solidus line, is described. The details of several methods of diffusion brazing, solders for various metals, the hardening mechanism of the brazed seam, and metallurgical examinations of brazed seams are described. D.E.W.

N65-11370# Royal Radar Establishment, Malvern (Gt. Brit.)
ELECTRON BEAM MACHINING Interim Report
P. A. Millard Oct. 1963 17 p
(RRE-MEMO-2023; AD-443625)

Apparatus for studying certain aspects of electron-beam machining has been assembled. The machine is described in some detail, and further improvements are suggested in the light of experience gained so far. The experimental determination of the spot size is described, and details of the results obtained using thin evaporated films are given. Author

N65-11372# Whirlpool Corp., St. Joseph, Mich. Research and Engineering Labs.
THERMOELECTRIC JUNCTIONING PROJECT Final Report
James E. Robinson 15 Jul. 1964 34 p refs
(Contract NObs-86483)
(AD-604901) OTS: $2.00

Various methods of surface cleaning the n- and p-type Peltier materials produced no difference in solderability of the materials. Also no increase in solderability was noted with the use of any specific flux tested. It was discovered that antimony is a necessary constituent in the bismuth–tin solders to achieve adhesion to the as-received surfaces of the bismuth-telluride thermoelectric materials. An electrolytic nickel-plating system was developed that enabled consistent and uniform nickel plating of the thermoelectric materials and resulted in good adhesion of the nickel plating to the thermoelectric materials. The nickel-plated materials could be soldered with many different solders and provided a wide spectrum of possible junction operating temperatures. Diffusion tests have shown that diffusion does not appear to be a problem with 60/40 tin–lead solder on nickel-plated elements or 50/2.5/47.5 bismuth–antimony–tin solder on as-received elements if the operating temperatures are 50° to 100° F below the melting point of the solder. Author

N65-11375# Whirlpool Corp., St. Joseph, Mich. Research and Engineering Labs.
THERMOELECTRIC JUNCTIONING PROJECT Progress Report, 1 Oct.–31 Dec. 1963
James E. Robinson 31 Jan. 1964 25 p
(Contract NObs-86483)
(Rept- 7; AD-604902)

Work included experimentation with sputtered nickel, rhodium, and tin films on thermoelectric materials and improvements in electrolytic nickel plating techniques. Diffusion and the effect of high temperatures for extended time were also investigated. A high vacuum system operating above room temperature was investigated for precleaning thermoelectric elements prior to junctioning. Author

N65-11477# Naval Ordnance Lab., White Oak, Md.
ULTRASONIC INSPECTION OF T-JOINT WELDS
R. A. Youshaw 15 May 1963 79 p refs
(NOLTR-63-93; AD-605592)

A study was made of the ultrasonic inspection method as applied to T-joint weldments typical of submarine hull construction. This work includes the design of a new test block for instrument calibration. Commercially available equipment was used with good results. Of 26 locations selected for cross-sectional examination, 25 contained a material defect at

the location indicated by ultrasonic inspection. A comparison is made between the ultrasonic macroscopic and radiographic analyses. Author

N65-11483# General Motors Corp., Bristol, Conn. New Departure Div.
INVESTIGATION OF HIGH TEMPERATURE BEARING ELEMENTS Progress Report, Dec. 1, 1963–Mar. 31, 1964
C. J. Zupkus, H. R. Ludwig, and A. R. Leveille 1 Apr. 1964 27 p refs
(Contract AF 33(615)-1208)
(PR-1; AD-605741)

A testing program was developed, aimed at screening bearing materials and lubricants. The paramount objectives are the establishment of specimen-testing techniques and methods of data analysis. Both rolling and sliding tests will be conducted in test rigs that will operate at temperatures of −100°, 1500° 2000°, and 2500° F. A total of eight ceramic and intermetallic materials will be screened initially. Author

N65-11491# General Technologies Corp., Alexandria, Va. Materials Div.
A STUDY OF HIGH MODULUS, HIGH STRENGTH FILAMENT MATERIALS BY DEPOSITION TECHNIQUES Bimonthly Progress Report, May 1–Jun. 30, 1964
L. G. Davies and J. C. Withers 15 Jul. 1964 14 p ref
(Contract NOw-64-0176-c)
(BMPR-4; AD-603403)

Aluminum oxide filaments were successfully produced. Coatings up to 1.5 mils were obtained on 0.001-in. tungsten substrates. The resulting filaments had an average tensile strength of 24×10^3 psi. The X-ray spectra of silicon carbide filaments made from $SiCl_4$, trichlorosilane, and trichloromethylsilane were compared. The filaments produced from the two silane compounds showed strong peaks of SiC, whereas the spectra for the $SiCl_4$ produced filaments were inconclusive. Work began on the production of beryllium filaments by the zinc reduction of $BeCl_2$. No successful deposit has been obtained to date. Author

N65-11568# Whirlpool Corp., St. Joseph, Mich. Research Labs.
THERMOELECTRIC JUNCTIONING PROJECT Progress Report, 1 Jan.–31 Mar. 1963
R. G. Sickert 30 Apr. 1963 19 p
(Contract NObs-86483)
(Rept.-4; AD-422684)

Several X-ray diffraction patterns of as-received and abraded thermoelectric materials were run. No evidence of crystalline film or deposits was noted. The cathodic etch apparatus was further improved to the point where surface stripping is extremely controllable. Evaluation of junction-resistance scanner data shows the apparatus measures surface effect at a junction and will not produce an average junction resistance. Assuming a gas monolayer may be present on the element surface and reinforced by aqueous fluxes, a nonaqueous molten $SnCl_2$ flux was used and found to produce excellent tinning characteristics. Success was also attained with the same flux and bismuth–antimony solder, which has a melting point of approximately 525° F. Reaction tests on materials have shown diffusion zones on soldered p- and n-type materials. The reaction rate for n-type grown or sintered material is approximately equal; however, p-type material shows a reaction rate well in excess of the n-type material. Author

N65-11594# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PRECISION VOLUME STAMPING BY VIBRATION METHOD
M. Ya. Karnov and V. I. Vlasov 5 Dec. 1963 10 p Transl. into ENGLISH from Mashinostr. (Kiev), no. 6. 1958 p 41–42
(FTD-MT-63-159; AD-605871)

The volume stamping of blanks of vanes from steel alloys in a vibration press, which utilized impacts of 1000 to 1300 per minute frequency and a stroke near 15 mm, is described. Up to 10% of the samples or blanks from construction steels, with an area of about 18 cm^3 and a thickness of 2.5 mm, could be deformed in a cold state, and a degree of 8% to 10% deformation for an area of about 30 cm^3 was observed in the hot sizing of blanks of steel vanes. G.G.

N65-11600# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EXPERIMENTAL PROOF OF THE ELASTOHYDRODYNAMIC EFFECT
A. V. Kol'chenko '28 May 1964 10 p refs Transl. into ENGLISH from Nauchn. Zap. Gos. Nauchn.-Issled. i Proektn. Inst. Ugol'n., Rudn. Neft. i Gaz. Prom. (Kiev), no. 9, 1962 p 24–28
(FTD-MT-64-47; AD-606740)

This is a study of electrohydrodynamic bearings that work on water lubricants. A new experimental method of direct measurements of the hydrodynamic flow rate of the lubricants through the working slot of the bearing, and through the lateral leaks of the lubricant from the slot is described. G.G.

N65-11601# Whirlpool Corp., St. Joseph, Mich. Research and Engineering Labs.
THERMOELECTRIC JUNCTIONING PROJECT Progress Report, 1 Jan.–31 Mar. 1964
James E. Robinson 30 Apr. 1964 21 p
(Contract NObs-86483)
(Rept.-8; AD-604903)

Work included experimentation with improvements in electrolytic nickel-plating of bismuth-telluride thermoelectric materials and in diffusion characteristics of various solders in bismuth-telluride thermoelectric materials. Author

N65-11604# General Motors Corp., Bristol, Conn. New Departure Div.
RESEARCH AND DEVELOPMENT OF AIRFRAME BEARINGS FOR AEROSPACE VEHICLES Progress Report, 1 Nov. 1962–31 Jan. 1963
R. J. Matt, J. B. Muratore, R. E. Murteza, and C. J. Zupkus 11 Feb. 1963 39 p refs
(Contract AF 33(657)-8431)
(PR-3; AD-602898)

A total of 153 Phase-1 tests were completed at temperatures of −100°, 1500°, 2000°, and 2500° F. Results have demonstrated significant differences in the coefficient of friction, wear, and load-carrying ability, and some promise of satisfactory bearing materials for the entire temperature range is indicated. It was agreed to discard four of the eight original Phase-1 test materials from further testing. The Phase-2 lubricant study is currently in progress, and four of the six lubricants have been selected. Consideration is being given to two additional lubricants. The Phase-3 ultrahigh-vacuum test rig components are being fabricated, and will be installed into the test chamber. Author

N65-11615# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DEVELOPMENT OF INDIVIDUAL MACHINE CONSTRUCTION BRANCHES
A. G. Omarovskiy 1 Oct. 1963 123 p refs Transl. into ENGLISH of Chapter 4 from the book, "Razvitiye i Razmeshcheniye Mashinostroyeniya v SSSR" Moscow, Izd-Vo Ekon. Lit., 1962 p 62–156
(FTD-MT-63-61/1+3+4; AD-602558)

Development of the following individual machine construction branches are discussed: "Machine-Tool and Tool Industry"; "Power Machine-Building and the Electrical Industry"; "Heavy Machinery Building"; "The Automobile Industry"; "Agricultural Machine Construction and Tractor Construction"; "Instrument-Making"; and "Production of Blanks (Castings, Forgings, and Dies)." P.V.E.

N65-11627# United States Rubber Co., Wayne, N.J. Research Center
RESEARCH AND DEVELOPMENT OF HIGH TENACITY FIBERS POLYOLEFINS Final Report, May 1–Jul. 31, 1964
H. P. Kato and J. S. Lasky 25 Aug. 1964 21 p
(Contract Nonr-3767(00)(X))
(AD-605222) OTS: $1.00

The research during the final quarter was centered on increased spinning rates and improved fiber strengths. Spinning speeds up to 900 ft/min were attained. This was made possible by using 0.040-inch-diameter spinnerets, and by going to much higher thermal jacket temperatures. The desired increase in fiber strength was not obtained. The summary of the study of melt spinning of polypropylene includes discussions of the limitations on spinning temperature, problems due to high viscosity of polyethylene, the approaches taken for the achievement of high-strength fibers, and the high breaking elongation properties of the fiber. It is concluded that the commercial feasibility of the high-molecular-weight fiber is reasonably well established. D.S.G.

N65-11633*# Tennessee U., Knoxville
THEORETICAL AND EXPERIMENTAL STUDIES OF VISCO-TYPE SHAFT SEALS Semiannual Progress Report, Apr. 15–Oct. 15, 1964
William K. Stair 23 Oct. 1964 20 p refs
(Grant NsG-587)
(NASA-CR-59596; ME-64-587-1) OTS Prices: HC $1.00/MF $0.50

The investigation into the theory and performance of the visco-type shaft seal under laminar and turbulent conditions was concerned mainly with the following: (1) critical analysis and evaluation of previously published data on the viscoseal and related devices; (2) analytical study with primary emphasis being given to the development of a turbulent theory of the viscoseal; (3) experiment design and programed calculation of viscoseal performance, based on an accepted laminar viscoseal theory; and (4) design and construction of experimental facilities. Critical review of all available data led to the identification of specific areas that require analytical and/or experimental study. The design of an experimental-test facility, now under construction, is described. P.V.E.

N65-11647# Virginia U., Charlottesville Research Labs. for the Engineering Sciences
RESEARCH INVESTIGATION OF MAGNETIC AND ELECTRIC FORCES FOR ROTATING SHAFT SUSPENSION Technical Progress Report, Jun.–Aug. 1963
M. G. Foster Sep. 1963 28 p refs
(Contract AF 33(657)-8352)
(EMI-3421-102-63U; AD-606084)

Rotating motor armatures, supported on magnetic fields without any contact between solid surfaces, have been spun at speeds of 3400 to 6000 rpm. This type of bearing requires an active servo in at least one dimension, and this servo is often found to couple, rather stubbornly, to flexure vibrations of mechanical elements of the system. Author

N65-11656# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
WAYS OF USING CARBON FLUORIDES AND CARBON CHLOROFLUORIDES AS HIGHLY-STABLE INSTRUMENT OILS
G. I. Fuks and M. M. Blekherov 2 Jan. 1964 14 p refs Transl. into ENGLISH Khim. i Tekhnol. Topliv i Masel (Moscow), no. 7, 1963 p 58–62
(FTD-MT-63-158; AD-606964)

Investigated was the use of aliphatic acids as additives to carbon fluoride and chlorofluoride to improve the stability of these instrument oils. It is concluded that aliphatic acids considerably improve the antifriction and antiwear properties of the oils. Due to poor solubility, the aliphatic acids must be distributed as highly dispersed particles. A condensation method is described for obtaining colloidal solutions that assures high stability by reducing stratification. The effectiveness of these additives begins only when the particles begin to melt and free molecules appear in the system to form a boundary layer; therefore, aliphatic acid additives are effective in the temperature range from 30° to 150°C and possibly higher, depending on the molecular weight of the chosen acid. To increase the adhesion of carbon fluoride oils and prevent drop formation, the instrument surfaces should be treated with a dewetting agent. M.P.G.

N65-11678# Joint Publications Research Service, Washington, D.C.
STUDIES IN BRAZING OF TITANIUM AND ELECTROSLAG WELDING
3 Dec. 1964 22 p Transl. into ENGLISH from Svarochnoye Proizvodstvo, (Moscow), no. 9, Sep. 1964
(JPRS-27673; TT-64-51860) OTS: $1.00

The process of brazing titanium and its alloys, using an electroplated copper coating, was studied. Brazing was done at various temperatures, and at constant pressures, and at holding times. Author

N65-11685# Naval Research Lab., Washington, D.C. Chemistry Div.
SURFACE CHEMICAL METHODS OF DISPLACING WATER AND/OR OILS AND SALVAGING FLOODED EQUIPMENT. PART 3: FIELD EXPERIENCE IN RECOVERING EQUIPMENT AND FUSELAGE OF HH 52A HELICOPTER AFTER SUBMERSION AT SEA
H. R. Baker and P. B. Leach 19 Oct. 1964 19 p refs
(NRL-6158; AD-608193) OTS: $0.50

The principle of displacing oils and water from surfaces has reduced drying-out time of wet equipment from days to hours. Utilizing these features, a salvage or reconditioning system for oil-contaminated and/or wet equipment has been developed. The system utilizes ultrasonic agitation and/or spray washing, as may be required by the complexity and the size of the apparatus. Detailed instructions for the salvage of helicopter equipment are given in an appendix. P.V.E.

N65-11724# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ALUMINUM ALLOYS Collection of Articles

I. N. Fridlyander, ed. 25 Aug. 1964 211 p Transl. into ENGLISH of the book "Alyuminiyevyye Splavy" Moscow, Gos. Nauchno-Tekhn. Izd. Oborongiz, 1963 p 1–176 (FTD-MT-64-196; AD-607564)

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24. OBTAINING OF STANDARD ALUMINUM ALLOYS BY THE METHOD OF POWDER METALLURGY I. N. Fridlyander, G. D. Agarkov, N.S. Klyagina, and R. A. Krivenko p 196–203 (See N65-11748 02-15)

N65-11727# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

FORM AND DIMENSION OF PARTICLES OF ALUMINUM POWDER FOR OBTAINING OF HALF-FINISHED PRODUCTS FROM SAP

M. G. Stepanova, N. I. Kolobnev, and L. I. Kibitova *In its* Aluminum Alloys 25 Aug. 1964 p 24–29 (See N65-11724 02-15)

Because studies of the influence of the duration of grinding on the dispersiveness and bulk weight of aluminum powder revealed that the enlargement of elementary particles and the increase of the bulk weight of the powder do not occur simultaneously, the form of the particles (as differentiated from the size of the particles) was investigated. Electron microscopy indicates that the following stages occur in ball milling: (1) the flattening of atomized aluminum to form particles of petal-like shape, accompanied by work hardening; (2) splitting of the petal-shaped particles into smaller particles whose length and width dimensions are of the same order of magnitude, accompanied by an increase in the bulk weight of the powder; and (3) joining of the smaller particles of powder into bigger particles or conglomerates, i.e., nodulizing of the powder. M.P.G.

N65-11728# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SAP FROM SECONDARY ALUMINUM

E. M. Lekarenko, G. N. Pokrovskaya, G. P. Zenkov, L. A. Sarul, and N. I. Kolobnev *In its* Aluminum Alloys 25 Aug. 1964 p 30–33 (See N65-11724 02-15)

The mechanical properties and corrosional stability of semi-finished products obtained from sintered aluminum powder (SAP) from secondary aluminum (1.1% Al_2O_3; 3.1% Si; 2.88% Cu; 1.56% Zn; 1.11% Fe; 0.01% Mn; 0.03% H_2O; remainder Al) were investigated. As a result of grinding and nodulizing, the content of Al_2O_3 in the obtained powder was increased to 7.2% and the bulk weight was increased to 1.44 g/cm^3. Comparisons of rods from this material with SAP rods from primary aluminum with 7% Al_2O_3 indicate that, at temperatures up to 350°C, the ultimate strength of SAP from secondary aluminum is higher, whereas at temperatures above 350° it becomes increasingly lower than SAP from primary aluminum. The relative elongation with increase of temperature from 20° to 150° to 200°C increases from 4% to 7.5% to 8%, but with further increase in temperature it decreases from 8% to 3.5%. The corrosional stability of SAP from secondary aluminum is lower than that of primary SAP and pure aluminum, but it is higher than the aluminum alloy D16. M.P.G.

N65-11729# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TECHNOLOGY OF EXTRUSION OF LARGE-DIMENSION HALF-FINISHED PRODUCTS FROM SAP
V. G. Kovrizhnykh, Yu. N. Ponagaybo, and V. I. Sverlov *In its* Aluminum Alloys 25 Aug. 1964 p 34–43 (See N65-11724 02-15)

A method of "hot briquetting" for obtaining large-dimension, pressed, semifinished products from sintered aluminum powder (SAP), using existing press equipment, is described. The correct selection of conditions for pressing using this technique is discussed; with proper heating temperatures and pressing speeds, high quality semifinished products with no bubbles and no internal stratifications can be obtained. This method has been used to produce rods from 45 to 170 mm in diameter and 30 × 405 mm strip. M.P.G.

N65-11731# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ROLLING OF SHEETS FROM SAP
M. F. Zakharov, F. V. Zhuravlev, S. I. Nomofilov, and V. A. Shelamov *In its* Aluminum Alloys 25 Aug. 1964 p 53–62 (See N65-11724 02-15)

The rolling of sheets of SAP material of 0.8- to 2.0-mm thickness, width less than 600 mm, and length of 1500 to 2500 mm is described. Hot rolling was conducted on a two-high mill with preheating of the rolled stock after every passage through the roller. However, the technology described was very difficult, and it is not recommended for serial production. Smaller sheets were obtained on a horizontal hydraulic press by cold briquetting with subsequent hot compacting of 60- to 80-kg billets of SAP and extrusion of 30 × 410 mm strip. From a sheet of such strip of length to 650 mm, stock of 4- to 5-mm thickness and 900- to 1300-mm width can be rolled by 7 to 9 passes through a trio mill. Cold rolling of such sheet and other technological operations can be executed on existing equipment. M.P.G.

N65-11733# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
IMPROVEMENT OF TECHNOLOGY OF PRODUCTION OF STOCK FROM SAP
E. A. Kuznetsova and A. A. Gelman *In its* Aluminum Alloys 25 Aug. 1964 p 70–77 (See N65-11724 02-15)

Results of two studies on the technology of manufacturing pressed semifinished products from SAP are reported. The first study showed that a change in temperature of compaction in the interval 450° to 550° C does not influence the structure or properties of compacts and pressed semifinished products. The second study indicated that further compaction of the briquette hot pressed from preheated powder does not have any essential influence on the structure and properties of semifinished products. M.P.G.

N65-11734# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF CERTAIN CONDITIONS OF HOT ROLLING SAP
V. A. Shelamov *In its* Aluminum Alloys 25 Aug. 1964 p 78–85 (See N65-11724 02-15)

The influence of processing parameters during hot rolling of pressed SAP compacts was investigated with the following results: (1) Absolute broadening determined experimentally is of the same order of magnitude as the theoretical value. (2) The coefficient of friction during rolling tends to sharply decrease with increased rolling temperature. (3) The specific pressure is increased with total reduction to 50% but drops with further increase of total reduction. (4) The coefficient of friction increases with increase of total reduction. (5) Changes in specific pressure and coefficient of friction can be explained by the thermal effect occurring during deformation. (6) The specific pressure decreases with increased rolling temperature. (7) Power parameters of rolling SAP differ significantly from those of rolling the usual aluminum alloys, but no differences in these parameters were noted in rolling preheated and nonheated SAP samples. M.P.G.

N65-11736# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TECHNOLOGY OF MANUFACTURE AND PROPERTIES OF FOIL FROM SAP
P. T. Vlasova, B. I. Matveev, P. V. Kishnev, V. A. Stelmashchuk, and S. N. Ananin *In its* Aluminum Alloys 25 Aug. 1964 p 95–98 (See N65-11724 02-15)

Results of studies reported indicate that to obtain foil of 0.05 mm or less in thickness, the use of SAP with Al_2O_3 content between 6% and 7% is recommended. Hot rolling must be conducted at temperatures between 450° to 500° C. Prolonged annealing of foil to a temperature of 400° C slightly lowers the ultimate strength; annealing at 500° C for 250 hrs decreases ultimate strength at room temperature by 4 to 5 kg/mm^2; and ultimate strength at 500° C is practically the same as unannealed foil. M.P.G.

N65-11737# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div
MANUFACTURE OF PIPES FROM SAP
P. V. Kishnev, A. A. Gelman, B. I. Matveev, and V. S. Zolotov *In its* Aluminum Alloys 25 Aug. 1964 p 99–107 (See N65-11724 02-15)

Reported investigations show that round and shaped pipes can be prepared from sintered aluminum powder (SAP) under factory conditions using existing equipment. Among the recommended manufacturing processes are pressing at a temperature of 450° to 500° C on vertical and horizontal hydraulic presses with specific pressure to 90 kg/mm^2 and pressing speeds of 1 m/sec, cold rolling of pressed pipes on cold rolling mills, and drawing on chain drawing machines. The best combination of strength and elongation is shown by pipes produced from aluminum powder containing 5.7% to 7.5% Al_2O_3. Secondary pressing of pipes from stock leads to lowering of ultimate strength and increase of elongation, whereas rolling and drawing increase the strength and decrease the elongation depending on the degree of deformation. Round and shaped pipes from SAP can be prepared with the same tolerances as pipes from aluminum alloys, and heating of pipe stock for pressing can be conducted in induction furnaces. M.P.G.

N65-11738# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TECHNOLOGY OF STAMPING OF ARTICLES FROM SAP
B. I. Matveev, I. R. Khanova, and E. I. Shchedrin *In its* Aluminum Alloys 25 Aug. 1964 p 108–116 (See N65-11724 02-15)

Investigations are reported on stamping articles from sintered aluminum powder (SAP) using stamping on hammers and stamping on presses with heating of stock to temperatures of 450° to 570° C. The results indicate that pressed rods have the best properties for stamping by hammer and that it is impossible to obtain high quality details in open stamps (even with application of an aluminum covering) from briquettes due to their low plasticity. Details stamped from sintered billets containing not more than 9% Al_2O_3 had the best mechanical properties. M.P.G.

N65-11740# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
WELDING OF SAP-1
Yu. V. Melnikov, V. V. Zyukin, and V. I. Oboturov *In its* Aluminum Alloys 25 Aug. 1964 p 124–134 (See N65-11724 02-15)

Investigations of welding by fusion and resistance welding of SAP-1 were performed on 1.5-mm-thick sheet samples obtained from pretreated briquettes. It was determined that argon arc welding of SAP-1, using flux Af-4A, is possible with the use of high-temperature annealing of briquettes. Strength of the welded joints constitutes 95% of the strength of the basic material at room temperature and 70% at 500° C. Roller and spot welding were also found to be possible; the strength of the spot-welded joints was found to be fully satisfactory and equivalent to the strength of welded joints of the high-strength aluminum alloys. M.P.G.

N65-11741# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ROLLING OF SHEET MATERIAL DIRECTLY FROM ALUMINUM POWDER
V. A. Onoprienko, V. G. Khromov, L. S. Romanova, and G. F. Tikhonov *In its* Aluminum Alloys 25 Aug. 1964 p 135–147 (See N65-11724 02-15)

The possibility of manufacturing sheet material directly by rolling of sintered aluminum powder (SAP) is demonstrated. For high-quality sheet, it is necessary to use definite fractions of separated powder of brand APS. Rolling can be conducted in both cold and hot states, but tapes rolled from heated powder have higher strength. Samples of sheet material from 1 to 0.05 mm were prepared and tested; at a degree of deformation higher than 50%, the ultimate strength, density, and hardness are decreased. The ultimate strength of the sheet material after hot and cold rolling at 20° C was 42 kg/mm^2, and at 480° C was 7 to 9 kg/mm^2. M.P.G.

N65-11743# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FUSION WELDING OF SAP
G. D. Nikiforov, S. N. Zhiznyakov, E. Ya. Bazurina, and B. I. Matveev *In its* Aluminum Alloys 25 Aug. 1964 p 154–160 (See N65-11724 02-15)

Ways of avoiding the causes of unsatisfactory arc-welding behavior of SAP-1 were investigated. Results indicate the following: (1) Weldable SAP sheets are not distended during heating to 900° C for 30 min, have heightened plasticity and high strength at room and high temperatures, and have an Al_2O_3 content between 6.9% and 10.6%. (2) When the aluminum alloy AMg6 is used as filler wire, the ultimate strength of the welded joints is 24 to 28 kg/mm^2 at room temperature and 5 to 6 kg/mm^2 at 500° C. (3) Mutual dissolution of the basic and filler materials occurs during welding. (4) Prolonged soaking of welded joints at 400° and 500° C does not change the ultimate strength at room temperature. M.P.G.

N65-11744# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BUTT RESISTANCE WELDING OF WIRE FROM SAP
V. K. Ivanov, P. V. Kishnev, and E. Ya. Bazurina *In its* Aluminum Alloys 25 Aug. 1964 p 161–168 (See N65-11724 02-15)

Studies indicating that a high-quality welded joint may be obtained only by simultaneous melting of both the Al and the Al_2O_3 components of sintered aluminum powder (SAP) are reported. Such fusion welding yields satisfactory joints in SAP wire that are able to withstand deformation during drawing. An industrial version of the machine used for butt welding by fusion should have arrangements for reliable holding and fast removal of wire of any length, a mechanism for exact centering of the joint, and an attachment for adjusting the secondary voltage in the range from 2.5 to 8 volts. M.P.G.

N65-11746# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
REPROCESSING OF WASTE SAP
N. A. Davydova, E. A. Kuznetsova, B. I. Matveev, and A. A. Gelman *In its* Aluminum Alloys 25 Aug. 1964 p 177–184 (See N65-11724 02-15)

Different methods of crushing large-size scraps of waste sintered aluminum powder (SAP) material, and also the influence of the degree of crushing on the structure and properties of the semifinished products made from reprocessed SAP were studied. Results indicate that, by mechanical crushing of waste SAP into small shavings, followed by briquetting and pressing, high-quality semifinished products can be obtained whose mechanical properties differ little from the original material. M.P.G.

N65-11748# Air Force Systems Comand, Wright-Patterson AFB, Ohio Foreign Technology Div.
OBTAINING OF STANDARD ALUMINUM ALLOYS BY THE METHOD OF POWDER METALLURGY
I. N. Fridlyander, G. D. Agarkov, N. S. Klyagina, and R. A. Krivenko *In its* Aluminum Alloys 25 Aug. 1964 p 196–203 (See N65-11724 02-15)

The possibility of using powder metallurgy techniques to obtain semifinished products from standard aluminum alloys B96 and D16 was investigated. The results indicate that alloys whose initial powders are prepared by atomization possess significantly higher properties than alloys whose powders are obtained by mixing of separate components. (2) Decrease in particle size leads to a significant increase in the mechanical properties of D16, but particle size does not affect the strength of B96. (3) The behavior of powder alloys B96 and D16 with more than 10% Al_2O_3 is approximately the same as SAP, whereas alloys with a small Al_2O_3 content act analogously to the usual cast alloys but have a more uniform structure. M.P.G.

N65-11801# Republic Aviation Corp., Farmingdale, N.Y. Manufacturing Research Dept.
ELECTRO-SPARK EXTRUDING Interim Technical Engineering Report No. 4, 1 Apr.–1 Jul. 1964
J. H. Wagner Wright-Patterson AFB, Ohio, ASD, Jul. 1964 26 p refs
(Contract AF 33(657)-11265)
(RAC-2491; ASD-TR-8-111; ASD-IR-8-111(IV); AD-602483)

General design criteria consisting of working pressure, pressure source, shock loading, and preliminary specifications of a pressure vessel to perform capacitor discharge extrusion from a 200 000-psi fluid pressure are discussed. Design criteria for the container, liner, insert, and die assembly components are presented. A pumping system to obtain pressures to 200 000 psi are proposed. Shielding of equipment and other safety considerations in working with ultrahigh pressures are outlined. Author

N65-11815# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
PROJECTION PHOTOLITHOGRAPHY FOR USE IN MICROCIRCUIT FABRICATION
William B. Glendinning, Sidney Marshall, Albert Mark, and Thomas F. Brooks May 1964 25 p refs
(USAEL-TR-2461; AD-607594)

A new photographic technique for use in the construction of photo and process masks is discussed. The projection writing technique has been used to produce various masks that are comparable in characteristics and quality to those currently being made via contact and other photographic techniques within the microelectronic industry. The zero-velocity writing method has produced process mask patterns with line boundary definition of less than 5μ. Rectangular corners of photo masks projected light images having rounded corners with radii of less than 10μ. Exposure time intervals of 2.0 to 4.0 sec were used to produce useful process mask patterns. Projection writing techniques were used to produce complex microcircuit-type photo masks using one-step reduction factors of 4.0 to 22.0. Writing velocities of 6.0 to 0.25 mm/sec produced useful photo mask forms upon high resolution plates. Author

N65-11816# Union Carbide Corp., Cleveland, Ohio Linde Div.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID TANTALUM ELECTROLYTIC CAPACITORS Quarterly Progress Report, 1 Jul–30 Sep. 1964
J. E. Riley [1964] 34 p
(Contract DA-36-039-AMC-03624(E))
(QPR-5; AD-608097)

Data are presented showing the relative capabilities of the various vendors' materials. These include finished device parameters and formation breakdown voltage. Under the formation studies, a method was developed that precisely determines the relative forming-voltage ability of sintered anodes, regardless of size, weight, density, etc. This method is fully described. All experimental data accumulated to date are presented, with the area of process study noted for each experiment. Author

N65-11818# ManLabs, Inc., Cambridge, Mass.
THERMOMECHANICAL TREATMENTS APPLIED TO ULTRA-HIGH STRENGTH STEELS Progress Report
D. Kalish and S. A. Kulin Sep. 1964 42 p refs
(Contract NOw-64-0356-c)
(PR-2; AD-607729)

A 0.45% C, 9% Ni, 4% Co alloy steel is being used to study the effect of thermomechanical treatments on high strength steels with particular interest in fracture toughness. The effort has been devoted to establishing the time–temperature transformation characteristic of this alloy, investigating the effect of tempering temperature on the mechanical properties and microstructure of martensite, and studying the influence of strain-tempering treatments on both martensitic and bainitic structures. Author

N65-11858# North American Aviation, Inc., Columbus, Ohio
QUALITY CONTROL AND NON-DESTRUCTIVE TESTING OF DIELECTRIC COMPONENTS USING THE MICROWAVE THICKNESS GAUGE
J. D. Leonard and G. T. Stropki *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2-4 Jun. 1964, Vol. V [1964] 5 p (See N65-11852 02-07)

The factors that enter into the design of radomes (physical thickness, incidence angle, relative dielectric constant, and wavelength) are interrelated and can be considered together in terms of "electrical thickness." It is this quantity that is observed in the various applications of interferometry to measurement and control problems. A highly successful device, a microwave thickness gage (MTG), was developed as a result of the need for greater precision in electrical thickness control. Radomes fabricated with the aid of the MTG have exhibited excellent electrical properties and repeatability without the need for individual tailoring. The theory of operation and a discussion of the gage sensitivity are presented. D.S.G.

N65-11879# General Motors Corp., Indianapolis, Ind. Allison Div.
ALLISON RESEARCH AND ENGINEERING, VOLUME NO. 2, SECOND QUARTER 1964
1964 20 p refs

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N65-11880# General Motors Corp., Indianapolis, Ind. Allison Div.
NEW LABORATORY TECHNIQUES APPLIED TO ENGINEERING AND QUALITY PROBLEMS ASSOCIATED WITH HIGH STRENGTH MATERIALS
C. F. Bradenburg, George R. Sippel, and Dean K. Hanink *In its* Allison Res. and Eng., Vol. No. 2, Second Quarter 1964 p 2–14 refs (See N65-11879 02-15)

Techniques designed to handle quality-control and engineering appraisals in a precise quantitative manner are described. These include rating of stainless-steel cleanliness; fracture-toughness testing, using a partial-thickness crack tensile test; fracture analysis with Fractograph replicas produced by using an electron microscope; and rapid identification of fracture planes, distinguishing between failure modes of brittle and ductile fracture or stress corrosion, using the electron probe microanalyzer. Applications of fracture-toughness testing to ultrahigh strength 18 Ni–CoMo maraging steel and to high-strength titanium alloy Ti-6Al-4V are discussed. M.P.G.

N65-11897# Union Carbide Corp., Tonawanda, N.Y. Cryogenic Development Lab.
COMPATIBILITY OF MATERIALS WITH 7500 PSI OXYGEN Final Report, Jun. 1963–Jun. 1964
G. J. Nihart and C. P. Smith Wright-Patterson AFB, Ohio, AMRL, Oct. 1964 90 p refs
(Contract AF 33(657)-11686)
(AMRL-TDR-64-76; AD-608260)

A research program was conducted to develop ignition data on thread lubricants, thread sealants, fluorocarbon plastics, and metals. Spontaneous ignition temperatures were determined in both 2000-psi and 7500-psi oxygen for all the above materials except metals. The spontaneous ignition temperatures for these materials were found to be essentially the same in 7500-psi oxygen and in 2000-psi oxygen. Only three of the tested lubricants are recommended for possible use in 7500-psi systems. None of the thread sealants are recommended. Glass-filled polytetrafluoroethylene is usable only if tightly confined. The relative ease of ignition of metals and alloys was determined by promoted ignition methods in oxygen at 7500 psi. Inconel alloy 600, brass, Monel alloy 400, and nickel were found to have the highest resistance to ignition and combustion among the common alloys and metals. Of the materials tested, stainless steel and aluminum are the least satisfactory for use at oxygen pressures of 7500 psi. A test system was constructed to evaluate the hazards in rapidly charging a 65-cu-in. nickel-lined vessel with high-pressure oxygen. A series of rapid charging tests up to and as high as

8000 psi proceeded without incident. Electrostatic charges measured during the charging were negligible. Author

N65-11911# Western Electric Co., Inc., Laureldale, Pa.
PRODUCTION ENGINEERING MEASURE: MECHANIZATION OF SEMICONDUCTOR DEVICES, 2N559–2N1094 Quarterly Progress Report, 1 Apr.–30 Jun. 1964
M. N. Reppert [1964] 44 p
(Contract DA-36-039-SC-72729)
(QPR-26; AD-606681)

The mechanization program for 2N559 and 2N1094 transistors was initiated to provide adequate production capability for the Nike-Zeus antimissile missile system. Refinement of one mechanized operation (data handling) was completed, bringing the total operations completed to six. Shop work on the stripe evaporation and alloying operation is in the final stage and is completed on the header internal lead-trimming operation. Experimental diffusion runs have demonstrated that a 5-pellet source produces tighter sheet resistance distributions than a 3-pellet source when low doping levels are required. Evaluations have yielded favorable results on developmental processes for ultrasonic emitter etching and wire bonding. The target areas of two types of infrared temperature detectors were experimentally verified; both detectors measured the temperatures of a calibrated blackbody source within a 2-percent accuracy. D.S.G.

N65-11913# Value Engineering Co., Alexandria, Va.
RESEARCH AND DEVELOPMENT OF EROSION AND OXIDATION RESISTANT COATINGS FOR GRAPHITE Second Quarterly Report, 13 Jun.–12 Sep. 1964
E. Goodman, R. Thompson, and T. Hogland 13 Oct. 1964 11 p
(Contract N-600(19)61804)
(Rept.-6-RD-64; AD-450128)

Several methods of producing an adherent chromium oxide layer on the surface of the electrodeposited chromium coating were studied. A two-cycle heat treatment and heat treatment at 1600° F in a partial atmosphere of argon produced a coating that, in some cases, protected the graphite substrate for one hour at 2700° F without failure of the coating-substrate composite. Tests of two grades of graphite having a coefficient of thermal expansion close to that of chromium indicated that they did not perform as well as the ATJ graphite, which was used as the substrate material in all previous coating studies. Author

N65-11919# Ohio State U. Research Foundation, Columbus
RESEARCH TO DEVELOP METHODS FOR MEASURING THE PROPERTIES OF PENETRANT FLAW INSPECTION MATERIALS Technical Report, Mar. 1962–20 Nov. 1963
Roy B. Mc Cauley and Quentin Van Winkle Wright-Patterson AFB, Ohio, AF Mater. Lab., Feb. 1964 139 p refs
(Contract AF 33(616)-6420)
(WADD-TR-60-520; AD-606217)

Production of cracked metal test specimens had to reach a final reproducible stage at which specific cracked specimens were selected to develop the needs of the measurement program. Final correlation proved the need for a greatly revised cleaning program prior to penetrant testing. At this point a standard cracked plate treatment was devised including the programs of cleaning, penetration, and washing in a standard manner. Both parallel and random cracked specimens were employed. To test the specific problem of aging, contamination, and other vicissitudes of the penetrant process, measurements were taken to determine their effect upon the final test. Ultimately the program proved that cleanliness prior to penetrant testing gave a very significant effect of success or lack of success in penetrant testing. The penetrant method proved to be an excellent method of revealing fine discontinuities when clean test specimens and properly developed procedures were used. Author

N65-11961# Air Force Systems Command, Edwards AFB, Calif.
DISK PUMP FEASIBILITY INVESTIGATION
R. O. Byrne 1 Jul. 1964 36 p refs
(RPL-TDR-64-119; AD-607975)

The disk pump was investigated to determine the feasibility of using a novel viscous pumping system as an inducer and/or mainstage pump for liquid rocket applications. This investigation consisted of the analysis, design, and test of a disk pump primarily for application as an inducer. The maximum suction specific speed reached was 55 400 in 70° F water, with no apparent head deterioration. The representative maximum suction specific speed at a 3% head drop was never reached. The pump demonstrated unusual stability characteristics throughout all tests even at ultralow NPSH values of 4.7 ft. Author

N65-11964# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Materials Processing Dept.
PRECISION FORGING PROGRAM FOR TURBINE WHEELS AND GEARS Final Report, 20 Jun. 1962–12 May 1964
Robert W. Redlinger and James A. Timura Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1964 120 p refs
(Contract AF 33(657)-8791)
(ML-TDR-64-283; AD-607369)

The radial extrusion process has been developed and demonstrated to be feasible as a method for precision-forging gears and turbine wheels with integral blades. A state-of-the-art survey indicated a need for an improved forming process to rapidly and economically fabricate the high-temperature metals and superalloys into advanced aircraft and aerospace components. The development program initiated to fulfill these objectives included a single-station screening phase to develop the process components and a full-scale effort to fabricate and evaluate turbine wheels and gears. Results of the screening tests used to evaluate expendable materials for forging die inserts showed a high-density alumina product to be most promising. Precision-cast steel inserts performed satisfactorily as permanent-type inserts. The success of using individual die inserts in a precision-forging operation depended on a unique hydraulic closure mechanism that adapted the forging tooling in an 8000-ton mechanical press. The developed process was used to produce high quality turbine wheels with integral blades from several superalloys. Author

N65-11993# Douglas Aircraft Co., Inc., Long Beach, Calif.
FLUID CONTAMINATION SURVEY OF 143 NAVAL AIRCRAFT HYDRAULIC SYSTEMS
N. F. Robinson 13 Mar. 1963 52 p refs
(Contract NOw-62-0297-t)
(LB-31228; AD-402711)

A survey of hydraulic fluid contamination was made in which 79 airplanes, plus several test stands, were sampled. The results are presented in tabular and graphical form. An analysis of the data of the survey leads to the conclusion that substantially cleaner systems can be maintained with no great increase in cost. Author

N65-12025# Arde-Portland, Inc., Paramus, N.J.
CRYOGENIC STRETCH-FORMING OF SOLID PROPELLANT ROCKET CASES Quarterly Report, Jun. 1–Aug. 31, 1964
R. H. Alper [1964] 17 p
(Contract DA-30-069-ORD-3501)
(QR-9; AD-606558)

The ease of fabrication of subscale cases was improved by final machining prior to aging. Three subscale high-strength vessel preforms were fabricated, and two were stretched; very high stress levels were successfully achieved during the cryogenic stretch-forming operation. Two full-scale preforms were completed and stretched. The basic problem that manifested itself during the stretch of the first preform consisted of severe buckling at the forward end of the case. A leak at the weld joint was attributed to the buckling, and a second case was stretched to confirm the conclusion. A design analysis was performed; several fixes for the buckling were considered; and a primary fix was decided upon to incorporate a means of preventing the buckling. D.S.G.

N65-12041# ARO, Inc., Arnold Air Force Station, Tenn.
PERFORMANCE TEST OF POWER TRANSMISSION SLIP RINGS IN VACUUM ENVIRONMENTS
D. L. Adkins Arnold Eng. Develop. Center, Nov. 1964 33 p ref
(Contract AF 40(600)-1000)
(AEDC-TDR-64-219; AD-451412)

A multiple slip-ring assembly was tested in a vacuum environmental chamber at a pressure in the mid 10^{-9} torr range. The test was a 700-hr performance and duration investigation. Each slip ring carried 75 A at a rotational speed of 15 rpm. During the test period, the physical and electrical characteristics of the assembly exhibited only small variations. The dynamic potential drop and peak electrical noise on the rings remained within limits acceptable for power-transmission application. Author

N65-12094# Ogden Air Materiel Area, Hill AFB, Utah 2705th Airmunitions Wing
SERVICE LIFE TEST OF FUEL SHUT-OFF VALVE FOR THE ADM-20 MISSILE Ammunitions Test Report
Kenneth A. Kartchner Nov. 1963 19 p
(OOY-TR-63-705; AD-423878)

The valves were divided into three groups for temperature conditioning. The three conditioning temperatures used were −65°, +75°, and +160° F. During the function test each valve was measured for bridge wire resistance and ignition delay. The average of the bridge wire resistance and ignition delay was well within specifications. Author

N65-12117# Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID ELECTROLYTE TANTALUM CAPACITORS Quarterly Report, Mar. 29–Jun. 29, 1964
J. M. Eckfeldt and J. H. D. Folster [1964] 31 p refs
(Contract DA-36-039-AMC-03621(E))
(QR-4; AD-605223) OTS: $2.00

The manufacture of experimental lots of the 330μf-6 V rating proceeded on schedule. Subsequent life test results have verified preliminary findings that the most promising technique investigated to date involved a combination of standard powder and a variation in the manganese dioxide coating process. Mechanization of the assembly operation continued, with approximately 90% of the equipment completed. Manufacture of experimental lots of eight other ratings was begun to provide units for evaluating the equipment designed to mechanize the assembly operation. Life testing on all experimental lots continued, with no catastrophic failures occurring to date on either the 85° C test or the 125° C test. On the lots that completed life testing or significant portions of these tests, the percentage of parameter drift failures was minimal. Author

N65-12119# Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR COLUMBIUM CAPACITORS Quarterly Report, Dec. 26, 1963–Mar. 26, 1964
J. H. D. Folster, E. E. Holley, and A. Whitman [1964] 13 p refs
(Contract DA-36-039-AMC-01468(E))
(QR-3; AD-605225) OTS: $1.00

Construction of the four ratings required for the preproduction sample was continued. One of these ratings is now ready for testing. A program to improve the present yield levels was begun. Data obtained so far indicate that reduction of the aging temperature will not solve the problem of room-temperature leakage-current instability. Investigation of the effects of capacitance and voltage derating are under way. The final data from the reanodization studies indicate that variations in electrolytes and temperatures produce no significant quality improvements. Author

N65-12121# Virginia U., Charlottesville Research Labs. for the Engineering Sciences
RESEARCH INVESTIGATION OF MAGNETIC AND ELECTRIC FORCES FOR ROTATING SHAFT SUSPENSION Technical Quarterly Progress Report, Jun.–Aug. 1964
C. D. Crawford, D. F. Nieman, and G. F. Theisz Sep. 1964 28 p refs
(Contract AF 33(657)-8364)
(EMI-3421-114-64U; AD-606159)

A passive radial system capable of operating a 36-watt induction motor at 3600 rpm, with arbitrary orientation relative to the vertical, is discussed. Radial stiffness is 1.7 lb per min. Net axial stiffness is 30 lb per milli-inch for the linear axial control, and 57 lb per min. for a dual-mode system. The radically active system has been used to support a 1-hp motor at 8000 rpm with no external load, at reduced excitation (7% of rated voltage). Successful operation at full excitation was found to be possible at 1200 rpm, employing 60 cps. Pulsed loads over a frequency range of 10 to 80 cps applied to the bearing system supporting a 36-watt induction motor resulted in no adverse effects. A detailed analysis was conducted in order to compute the radial force gradient for an eccentric rotor–stator configuration of an induction motor. P.V.E.

N65-12144# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio TRW Electromechanical Div.
OXIDATION RESISTANT HIGH TEMPERATURE PROTECTIVE COATINGS FOR TUNGSTEN Technical Documentary Report, 15 May 1963–15 May 1964
H. J. Nolting and R. A. Jefferys Wright-Patterson AFB, Ohio, AF Mater. Lab., Jul. 1964 126 p
(Contract AF 33(657)-11151)
(ML-TDR-64-227; AD-608510)

A controlled process has been established for application of silicon–tungsten and of titanium + zirconium + silicon–tungsten coatings to tungsten sheet. Protective capabilities of these coatings on arc cast and powder product tungsten sheet have been determined at one atmosphere (air) from 1600 to 3600° F under cyclic conditions. Various refractory compound mixtures plasma sprayed on tungsten sheet were not protective at elevated temperatures in air. A silicon–tungsten + titanium nitride–boron nitride coating combination protected tungsten for short periods of time at 3700° F. Tensile properties

were determined for silicon–tungsten and for titanium + zirconium + silicon–tungsten-coated arc-cast tungsten sheet at various temperatures to 3300° F. In stress oxidation tests the same systems loaded at 20 percent of the yield strength showed essentially no creep after 1 hour at 3350° F in air. The coatings were completely protective at this stress level. Author

N65-12148# Advanced Metals Research Corp., Somerville, Mass.
TECHNIQUES FOR IDENTIFICATION HANDLING AND ANALYSIS OF EXTRA-TERRESTRIAL PARTICLES Final Report
M. Plansky and R. F. Carnevale 30 Apr. 1964 32 p
(Contract AF 19(628)-2761)
(AFCRL-64-540; AD-603964)

A technique is described for inflight shadowing of collected upper atmosphere particles, which enables the discrimination of contamination particles from extraterrestrial particles. A method is also described of transferring submicron particles from the electron microscope substrates to beryllium discs for chemical analysis by employing the electron probe. Electron microscopic examination of samples from a rocket collection and size distribution of the collected particles are discussed and evaluated. Electron-probe qualitative analysis of a number of collected particles after transfer to a beryllium disc has demonstrated the feasibility of this technique as an aid in particle identification. Author

N65-12218*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
PERFORMANCE OF 84° FLAT-PLATE HELICAL INDUCER AND COMPARISON WITH PERFORMANCE OF SIMILAR 78° AND 80.6° INDUCERS
Douglas A. Anderson, Richard F. Soltis, and Donald M. Sandercock Washington, NASA, Dec. 1964 31 p refs
(NASA-TN-D-2553) OTS Prices: HC $2.00/MF $0.50

A flat-plate, constant-lead helical inducer with an 84° tip angle was tested in a water tunnel. The inducer was tested in cold water over a range of flow rates at various net positive suction heads. Both the overall performance and the radial distributions of flow parameters were observed. The radial distributions describe the type of flow patterns occurring across the rotor and show the radial variation of flow conditions that a succeeding pump stage must accept. The validity of the simple radial equilibrium assumption over a range of flow conditions is verified. The performance of this 84° helical inducer is compared with the performance of similar inducers with tip helix angles of 78° and 80.6°. A given percentage decrease in performance from the noncavitating level is achieved at decreasing values of cavitation number as the blade tip helix angle is increased. Obtaining lower cavitation numbers through the use of higher helix angle blading, however, does not necessarily mean obtaining increased suction specific speeds. Author

N65-12241# Aerospace Corp., El Segundo, Calif. Electronics Div.
FLUID FLYWHEEL ATTITUDE CONTROL SYSTEM STUDIES
D. J. Griep 17 Aug. 1964 51 p refs
(Contract AF 04(695)-269)
(TOR-269(4540-70)-5; AD-606316) OTS: $3.00

A single-axis attitude control system using a fluid flywheel as the torque-producing element is analyzed. The control laws that are either analyzed or derived are proportional control, minimum orientation time control, and minimum electrical-power consumption control. Pontryagin's maximum principle was used to derive the latter two control laws. Experimental laboratory data are presented for the proportional control system. The smooth, low-velocity performance obtained using a fluid flywheel is demonstrated. Author

N65-12248# Mallory (P.R.) and Co., Inc., Indianapolis, Ind.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID ELECTROLYTE TANTALUM CAPACITORS Quarterly Report, 30 Mar.–29 Jun. 1964
A. W. H. Smith [1964] 20 p
(Contract DA-36-039-AMC-03623(E))
(QR-4; AD-604434)

The remaining materials evaluation tasks have been completed. Work on anode pressing, anodization, and reformation is finished except for specification review. Presintering studies have uncovered some possible deficiencies in the binder-lubricant selected for study. Improvements in furnace design and control have been made. Author

N65-12256# Kaysam Corp. of America, Paterson, N.J.
PRODUCTION ENGINEERING MEASURE FOR MANUFACTURE OF METEOROLOGICAL BALLOONS TYPE ML-541 ( ) UM Quarterly Progress Report, 19 Apr.–18 Jul. 1964
Frank Sterne [1964] 11 p
(Contract DA-36-039-SC-85988)
(QPR-9; AD-605546)

Both sections of the automatic dipping machine are working well, with only an occasional minor adjustment being required. Check valves for all inflation arms of the conveyorized drying system have been installed and are working well. With the approval of the rate of rise allowance made for helium, the preproduction samples have now been accepted. Author

N65-12276# Bureau of Reclamation, Denver, Colo. Chemical Engineering Branch
MOISTURE ABSORPTION OF HOT-MELT COATINGS Final Report
C. E. Selander 3 Jun. 1964 25 p refs
(ChE-11; AD-606206) OTS: $2.00

The moisture-absorption properties of various hot-melt coatings have been investigated for periods up to 14 2/3 years. It was found that low penetration coal-tar enamel established the lowest absorption rate of the 11 materials tested. It was also found that after 5 years each material reached a stabilized moisture-absorption rate. This report covers the performance of four materials remaining in test after 8 years of exposure. Previous progress reports are referenced. Author

N65-12278# Air Proving Ground Center, Eglin AFB, Fla.
A PROCEDURE FOR ESTIMATING DOWNWIND DEPOSITION OF SMALL SPRAY DROPLETS
Juri V. Nou Sep. 1964 21 p refs
(APGC-TR-64-66; AD-606216) OTS: $2.00

A procedure is described for estimating the amount and the extent of downwind deposition of liquid spray droplets in the 10μ to 200μ diameter range in terms of mass per area. The approach is based on Stokes' law and an assumed drop-size distribution. A sample solution of a practical problem follows the theoretical discussion. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-11131# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
RESEARCH ON TECHNIQUES FOR LIGHT MODULATION DETECTION. PART I: AMPLITUDE DEMODULATORS Final Report, 15 May 1962–15 May 1963
B. J. Mc Murtry, D. E. Caddes, R. Targ, A. E. Siegmen, and R.T. McKenzie Wright-Patterson AFB, Ohio, AF Avionics Lab., Jun. 1964 138 p refs
(Contract AF 33(657)-8995)
(AL-TDR-64-181, Pt. 1; AD-605478)

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2. THE TRAVELING-WAVE PHOTOTUBE. PART I: THEORETICAL ANALYSIS D. E. Caddes, B. J. Mc Murtry, and A. E. Jacquez 10 p refs
3. THE TRAVELING-WAVE PHOTOTUBE. PART II: EXPERIMENTAL ANALYSIS R. Targ, D. E. Caddes, and B. J. Mc Murtry 8 p refs

N65-11333# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio
INVESTIGATION OF A LASER TRIGGERED SPARK GAP
Winston K. Pendleton (M.S. Thesis) Aug. 1964 58 p refs
(GNE/PHYS/64-13; AD-603613)

A focused, Q-spoiled laser beam was used to produce an arc in a sphere-sphere electrical gap charged to within 30% to 90% of self-breakdown. The time response of the triggering was measured as a function of: laser beam power, 0 to 80 MW; fill gas, SF_6, N_2, Air; gas pressure, 100 to 1400 mm of Hg; electrode spacing, 0.4 to 1.5 cm; gap electric field, 10 to 100 kV/cm; and focus point location. Short delay times as low as 20 nsec were measured in SF_6 at atmospheric pressure. Generally delay times varied inversely with the electric field, gas pressure, and focus point distance from the anode surface. The results obtained were considered consistent with those predicted by the streamer theory of arc formation. Author

N65-11773# California U., Berkeley Electronics Research Lab.
LASER BEAM EXCITATION OF LASERS Final Report
J. R. Singer 31 Aug. 1964 7 p refs *Its* Rept.-64-33
(Contract DA-ARO-D-31-124-G-317)
(AROD-3323-5; AD-607783)

The optical maser (laser) excitation of another optical maser has been shown to the theoretically practical. The method of excitation consists of providing a pulse of laser radiation at the appropriate wavelength and for the appropriate length of time to cause a 180° inversion in the population levels of a laser material. Reasons for the importance of the 180° inversion laser-excitation method are these: (1) There is essentially no heat loss in the excitation process and cooling is not necessary. (2) The inversion is practically complete, and more laser output from the excited laser is available than with other excitation methods for solid laser materials. (3) The excitation process is, essentially, more efficient. P.V.E.

N65-11823# Sperry Gyroscope Co., Great Neck, N.Y. Electro-Optics Group
LASER MODE INTERACTION STUDIES Final Report
S. A. Collins, Jr., C. C. Wang, and E. W. Chesthem Aug. 1964 34 p refs
(Contract AF 19(628)-2924)
(AB-1272-0021; AFCRL-64-701; AD-608175)

The optical resonator theory was experimentally applied to a triangular ring optical resonator. Beat frequencies between various modes were measured. The results were in agreement with the analytically predicted frequencies. A GaAs diode laser with an external ellipsoidal mirror was analyzed and experimentally studied. Reduction of spot size is treated, and the apparatus to position the diode–mirror combination is described. Dual, canted, Fabry–Perot mode-selector etalons were experimentally studied with a ruby laser. Beam-angle narrowing in two dimensions is shown. The theory of frequency selectivity and angle narrowing is reviewed. Author

N65-11886# Sperry Gyroscope Co., Great Neck, N.Y. Electro-Optics Group
COHERENT OPTICAL ARRAY TECHNIQUES Interim Technical Documentary Report, 1 Mar.–31 May, 1964
Griffiss AFB, N.Y., RADC, Sep. 1964 71 p refs
(Contract AF 30(602)-3329)
(AB-1272-0016-1; RADC-TDR-64-315; AD-608220)

The overall plan is to demonstrate feasibility by developing a subassembly consisting of a cw-laser master oscillator driving two pulsed-laser power amplifiers in parallel. The required phase shifters and power dividers would be incorporated to demonstrate the principles of a coherent optical phased array. The investigation is being conducted for an operating wavelength of 1.06 microns. Solid-state and gas lasers are being considered for the master oscillator. Each type has been developed for fully cw operation in the vicinity of 1.06 microns. Solid-state crystals have been grown, cut, polished, and coated for amplifier functions of the same wavelength. Gain of several decibels has been measured. Author

N65-12279# Sylvania Electric Products, Inc., Mountain View, Calif. Optics Dept.
LIGHT MODULATION DETECTOR Interim Engineering Report No. 1, 15 Apr.–15 Jul. 1964
Russell Targ, D. E. Caddes, E. O. Ammann, G. A. Massey, S. E. Harris et al 20 Jul. 1964 66 p refs
(Contract AF 33(615)-1938)
(FDL-M739; AD-604022)

The work was divided into three main phases: (1) the development of a single-sideband suppressed-carrier-laser local oscillator with maximum power; (2) control of the modes of a laser by interferometric means to assure monochromatic output; and (3) design of an automatic frequency control system to tune the laser LO in frequency in accordance with the changes in the carrier frequency of an incoming signal from an independent laser transmitter. Work is also reported on techniques that allow certain electro-optic devices such as light modulators and shutters to be used with arbitrarily polarized light. Author

N65-12282# Conductron Corp., Ann Arbor, Mich.
COHERENT LIGHT INVESTIGATION, VOLUME I
G. Cochran et al Wright-Patterson AFB, Ohio, ASD, Mar. 1964 181 p refs
(Contract AF 33(615)-1014)
(D-5210-70-T80-110; AD-606323) OTS: $5.00

Although both the coherent and incoherent nature of light can be completely treated by wave mechanics methods, a simplified approach can be used. The latter is divided into the use of quantum theory when light is radiated or adsorbed by a material such as an atom and the use of the classical Maxwell theory to explain transfer functions, diffraction effects, and interference of light. Transfer-function mathematics are developed whereby the electromagnetic field of three-dimensional space at one position may be described as a function of the three-dimensional electromagnetic field at another position in space. Propagation of energy at optical wavelengths can be treated when such energy is transmitted through gas or solid materials in which statistically or mathematically describable perturbations of phase take place. A comparison of optical and microwave radars and a discussion of the use of a laser in optical measurements are included. M.P.G.

N65-12290# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
INVESTIGATION OF OPTICAL DOPPLER SUBCARRIER REFLECTED SIGNAL LOSS ATTRIBUTED TO COHERENCE EFFECTS AT HIGH MODULATION FREQUENCIES
Ronald James Basso (M.S. Thesis) Jun. 1964 114 p refs
(GGC/EE/64-2; AD-604067) OTS: $5.00

The theoretical discussion indicates the subcarrier remains coherent after reflection from optically diffuse targets. To verify this analysis, the output of an HeNe cw gas laser is split into two beams of equal intensity, each of which is reflected back to a photomultiplier by two diffuse targets. The results indicate that the received subcarrier amplitude varies as the cos $(\pi\Delta l/\lambda_m)$ where Δl is the path differences, and λ_m is the subcarrier wavelength. Since the phase relationship is predictable, it is concluded that the theoretical analysis is correct. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-10988# Joint Publications Research Service, Washington, D.C.
CORROSION OF MAGNESIUM ALLOYS
M. A. Timonova 19 Nov. 1964 29 p refs Transl. into ENGLISH from the book "Korroziya i Zashchita Magniyevykh Splavov", Moscow, 1964 p 53-63, 114-118, 137-139
(JPRS-27451; TT-64-51700)

Presented are brief discussions of investigations involving the following: (1) "Corrosion of Cast Alloys"; (2) "Corrosion of Alloys of the System Mg-Al-Zn-Mn"; (3) "Corrosion of Binary and Ternary Alloys, Alloyed with Rare-Earth and Other Elements"; (4) "Corrosion of Alloy VM65-1 (System Mg-Zn-Zr)"; and (5) "Corrosion of Alloys of the Systems Mg-Th-Mn, Mg-Th-Zr, and Mg-Th-Zn-Zr." P.V.E.

N65-10994# Titanium Metals Corp. of America, Toronto, Ohio
MECHANICAL SCALE REMOVAL FROM TITANIUM ALLOY SHEET Final Technical Documentary Report, Aug. 1958-Jun. 1963
K. W. Curry, T. P. Broderick, and G. M. Richmond Wright-Patterson AFB, Ohio, Met. Process. Branch, Oct. 1963 53 p
(Contract AF 33(600)-37502)
(ASD-TDR-63-849; AD-423730)

Two sheet alloys of titanium, Ti-6Al-4V and Ti-4Al-3Mo-1V, were investigated in developing a mechanical means of removing the scale and oxygen-rich layer formed on sheets during processing at elevated temperature. The recommended process involves descaling with Scotch-brite, coarse grinding to remove the oxygen-rich layer, fine grind for removal of the deeper notches, and polishing with Scotch-brite to condition grind lines. Production-size sheet processed through this sequence met specifications for bend ductility. Preliminary investigations were made of three processes for mechanically removing the scale and oxygen-rich layers—grit or shot blasting, wide-belt grinding, and wire brushing. Additional process investigation of wire brushing and further refinement of wide-belt grinding techniques resulted in the selection of a three-step process for accomplishing the objectives—descale sheet with wire brush and slurry process, grind to remove oxygen rich layer, and polish with sisal and cloth wheel to condition grind lines. Author

N65-10996# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
MODULUS OF ELASTICITY OF Ti-8Al-1Mo-1V TITANIUM ALLOY
Donald A. Shinn Sep. 1964 11 p
(MAA-TM-64-29; AD-605618)

The potential of extensive applications of 8Al-1Mo-1V titanium alloy to major aircraft structures suggests that its elastic properties be well substantiated. Several tests were made to establish accurate values for the modulus of elasticity for this material. Data from three different sources, the majority of which were obtained with highly sensitive optical strain-gages are reported. Author

N65-11002*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
VAPORIZATION OF TANTALUM-CARBIDE-HAFNIUM-CARBIDE SOLID SOLUTIONS AT 2500° TO 3000°K
Daniel L. Deadmore Washington, NASA, Nov. 1964 15 p refs Presented at the Am. Ceram. Soc. Meeting, Chicago, 22 Apr. 1964
(NASA-TN-D-2512) OTS Prices: HC $0.50/MF $0.50

The vaporization rates in vacuum of hot-pressed hafnium carbide, tantalum carbide, and solid solutions of these two carbides in the temperature range of 2500° to 3000° K were determined by a Langmuir-type method. The results show that a composition consisting of approximately 70-mole-percent tantalum carbide and 30-mole-percent hafnium carbide exhibits the lowest vaporization rate of any composition within this pseudobinary system. Variations in initial sample bulk density and vapor-specie condensation on the furnace wall have negligible effects on the measured vaporization rates. Preliminary information concerning the influence of time on the vaporization rate of selected compositions is discussed. Author

N65-11014# Oak Ridge National Lab., Tenn. Metals and Ceramic Div.
SOME OBSERVATIONS OF THE INTERGRANULAR CORROSION OF IRRADIATED TYPE 304 STAINLESS STEEL
E. L. Long, Jr. and C. Michelson Nov. 1964 31 p refs
(Contract W-7405-ENG-26)
(ORNL-3684) OTS: $2.00

Five prototype instrumented fuel elements for the experimental gas-cooled reactor were irradiated in a helium-cooled loop at cladding temperatures to 1500° F and burnups to 0.1 at. % U. These elements contained high-density, sintered UO_2 fuel bushings clad with type-304 stainless-steel tubing. During the postirradiation examination of certain of these test elements, some localized intergranular corrosion of the cladding was observed. In addition, extensive intergranular attack of type-304 stainless steel was detected in components operating adjacent to the test element but at lower temperatures (800° to 1200° F). This report discusses these observations and includes photographs and photomicrographs of typical corroded areas. The observations indicate that storage of sensitized, irradiated type-304 stainless steel in a high-humidity environment or underwater may lead to extensive intergranular corrosion.

Author

N65-11022*# Atomics International, Canoga Park, Calif.
SOLUBILITY AND DIFFUSION STUDIES OF ULTRA PURE TRANSITION ELEMENTS IN ULTRA PURE ALKALI METALS Fifth Quarterly Report, 28 Jun.–3 Oct. 1964
R. L. Mc Kisson and R. L. Eichelberger 16 Nov. 1964 31 p refs
(Contract NAS3-4163)
(NASA-CR-54095; AI-64-235) OTS Prices: HC $2.00/MF $0.50

Preparations are reported for solubility measurements of transition metals and compounds in alkali metal up to 1200° C, and for the measurement of the liquid-state diffusion rate and its energy activation, also to 1200° C. The potassium-purification unit has been completed and operated; however, the first batch of distilled potassium showed an oxygen level too high for use in the solubility tests. Manipulator modifications that allow sampling and handling of potassium in a vacuum below 1×10^{-6} torr are reported. The single-crystal refractory-metal crucibles have not been delivered because of electrochemical-machining processing difficulties. Difficulties have also been encountered in obtaining 1/2-in.-diameter single crystals of molybdenum and niobium. Analytical methods have been verified in the 1- to 10-ppm range for all of the solute materials in potassium. M.P.G.

N65-11023*# General Electric Co., Cincinnati, Ohio Missile and Space Div.
STUDIES OF ALKALI METAL CORROSION ON MATERIALS FOR ADVANCED SPACE POWER SYSTEMS Quarterly Progress Report 1, 26 Jun.–26 Sep. 1964
R. W. Harrison [1964] 27 p refs
(Contract NAS3-6012)
(NASA-CR-54200) OTS Prices: HC $2.00/MF $0.50

Preparations for stress-corrosion reflux capsule tests to determine the influence of stress on the corrosion behavior of D-43 columbium-based advanced alloy in potassium are reported. Preparations are also being made for bimetallic isothermal capsule tests to investigate corrosion mass-transfer effects in a stainless steel–columbium alloy–potassium system. M.P.G.

N65-11029# Joint Publications Research Service, Washington, D.C.
THE PHYSICAL NATURE OF ANOMALIES IN THE PLASTICITY OF METALLIC ALLOYS
A. A. Presnyakov 23 Nov. 1964 52 p refs Transl. into ENGLISH from the book "Fizicheskaya Priroda Anomaliy Plastichnosti u Metallicheskikh Splavov" Alma Ata, 1963 p 1–64
(JPRS-27500; TT-64-51749) OTS: $3.00

Using copper and aluminum alloys as examples, the physical nature of anomalies in plasticity is characterized in a fairly detailed manner. Both collapses in plasticity, i.e., a sharp decrease in plasticity indices, and the opposite, extraordinarily high indices accompanying superplasticity, are evoked by the development of side diffusion processes during the course of deformation. In the investigated systems, these processes are in the forms of recrystallization, change in solubility of components with temperature, ordering of alloys, and stabilization. It is stated that, in order to determine the reasons for low plasticity in technical alloys during treatment under pressure, a manifold analysis is necessary of data on the possible processes taking place, instead of a calculation only of the concentration of the impurities present, as was done in the reported work. D.E.W.

N65-11035# Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
NICKEL-GADOLINIUM PHASE DIAGRAM
M. I. Copeland, M. Krug, C. E. Armantrout, and H. Kato 1964 28 p refs
(BM-RI-6566)

The investigation of the nickel–gadolinium phase diagram was undertaken to determine the alloying behavior of these two metals. The data from melting-point determinations, thermal analyses, metallographic examinations, and X-ray diffraction analyses revealed a phase diagram with three eutectic points and seven intermetallic compounds. Very limited solubility of the phases in each other was observed. The five phases, $Ni_{15}Gd_2$, Ni_7Gd_2, Ni_3Gd, Ni_2Gd, and $NiGd_3$, melted incongruently at about 1300°, 1270°, 1180°, 1070°, and 775° C, respectively. The Ni_5Gd and NiGd melted congruently at approximately 1550° and 980° C, respectively. Four of the compounds were determined to crystallize in the hexagonal system: $Ni_{15}Gd_2$, Ni_5Gd, Ni_7Gd_2, and Ni_3Gd. Ni_2Gd was determined to be cubic, and NiGd to be orthorhombic. The crystal system of $NiGd_3$ was not determined. The eutectic points occurred at 13, 67, and 85 wt.% gadolinium, and the isotherms at 1290°, 890°, and 700° C, respectively. Author

N65-11046*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EFFECTS OF LOW TEMPERATURES ON STRUCTURAL METALS
H. L. Martin, A. G. Imgran, and W. S. Lyman (Battelle Memorial Inst.) Washington, NASA, Dec. 1964 60 p refs Prepared in cooperation with Battelle Mem. Inst.
(Contract NASr-100(02))
(NASA-SP-5012) GPO Price $0.40; OTS Price MF $0.50

The application of various metallic materials at cryogenic temperatures was evaluated. Aluminum alloys, nickel alloys, steel alloys, and titanium and magnesium alloys were investigated, and data on their tensile properties are presented. The austenitic stainless steels retained a high ductility at temperatures down to −423° F, and alpha titanium alloys were considered an appropriate choice for low-temperature service when weight considerations are of importance. Some liquifying and solidifying temperatures of several common substances often involved in low-temperature engineering-design problems are given in an appendix. G.G.

N65-11065# Du Pont de Nemours (E.I.) and Co., Wilmington, Del. Pigments Dept.
HIGH TEMPERATURE THERMOELECTRIC GENERATOR Quarterly Report, Oct. 1–Dec. 31, 1963

W. T. Hicks and H. Valdsaar [1963] 12 p
(Contract NObs-88639)
(AD-604904)

A new, thermoelectric alloy with a negative Seebeck coefficient has been investigated, Au-9 wt.% Ni. The physical and chemical properties of this alloy are superior to those of constantan used in earlier work as the negative leg and encapsulant for segmented p-type legs of Ta-doped WSe_2 and PbTe. The gold alloy has a higher Seebeck coefficient than constantan, does not react with Se vapors, and is oxidation resistant. Design of thermoelectric modules has been altered to make use of the new alloy. No change is required in design of the generator. Preparation and processing of WSe_2 have been standardized. Some earlier results on modules using constantan are summarized. Author

N65-11153# IIT Research Inst., Chicago, Ill.
EMBRITTLEMENT OF METALS BY ORGANIC LIQUIDS Quarterly Report, 1 Jun.–31 Aug. 1964
W. Rostoker and H. Nichols 10 Sep. 1964 10 p
(Contract DA-11-ORD-022-3108)
(IITRI-B183B2-6; AD-447094)

Evidence is presented that water absorption tends to obscure the degree of embrittlement by pure organic liquids under certain conditions of testing. Embrittlement by a number of metallo–organic, amine, and phenol liquids is demonstrated. None of the organic groups studied is more effective than those possessing -OH or -O- groups. Author

N65-11154# Brush Beryllium Co., Cleveland, Ohio
DEVELOPMENT OF VERY HIGH STRENGTH BERYLLIUM WIRE Bimonthly Report No. 4, 6 Jun.–6 Aug. 1964
E. A. Murphy and R. G. O'Rourke 6 Aug. 1964 10 p refs
(Contract NOw-64-0162-c)
(TR-367-243; AD-447224)

The results of a process to produce high strength beryllium fine wire are described. Known material chemistry for the 5% copper-beryllium alloy remake, and for the $-20\mu + 10\mu$, Lot No. SOV 68 is listed. Both materials were successfully extruded. Lot No. SOV 68 material was found to have good drawability. Author

N65-11181# Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
QUARTERLY-METALLURGICAL PROGRESS REPORT NUMBER 24, JULY 1–SEPTEMBER 30, 1964
A. H. Roberson [1964] 30 p refs
(Contract AT(11-1)-599)
(USBM-RC-1135) OTS: $2.00

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5. TUNGSTEN-RHENIUM TUBING DEVELOPMENT H. Kato, R. A. Beall et al p 16–20 (See N65-11183 02-17)
6. RHENIUM AND RHENIUM-BASE ALLOYS H. Kato et al p 21

N65-11182# Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
HIGH MELTING POINT CARBIDES (HfC)
R. A. Beall, H. Kato et al *In its* Quart. Met. Progr. Rept. No. 24, Jul. 1–Sep. 30, 1964 [1964] p 3–6 (See N65-11181 02-17) OTS: $2.00

Improvements in the hafnium-carbide casting equipment have led to preparation of cast-to-shape threaded tensile specimens. The tensile strength of hafnium carbide castings containing excess carbon was determined. Strengths of 5840 to 6540 psi at 2420° to 2470° C were calculated from the test data. Environmental chamber temperature corrections and vaporization losses for hafnium carbides were studied prior to conducting reactivity studies. Author

N65-11183# Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
TUNGSTEN-RHENIUM TUBING DEVELOPMENT
H. Kato, R. A. Beall et al *In its* Quart. Met. Progr. Rept. No. 24, Jul. 1–Sep. 30, 1964 [1964] p 16–20 (See N65-11181 02-17) OTS: $2.00

With the redirection of the melting research on the tungsten–rhenium tubing program, emphasis was placed on preparation of cold-mold ingots. To date, four have been melted and are being conditioned preparatory to extrusion. Evaluation of W-25 Re sleeves was continued, and density, rhenium-content, impurity-content, and grain-size data were obtained. Author

N65-11235# Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
DEVELOPMENT OF COLUMBIUM AND TANTALUM ALLOYS FOR ELEVATED-TEMPERATURE SERVICE
Herbert R. Babitzke, R. E. Siemens, G. Asai, and H. Kato 1964 38 p refs
(BM-RI-6558)

The purpose of this investigation was to develop a wide variety of columbium and tantalum alloys and to determine their suitability for use at elevated temperatures. Sixty-nine columbium and tantalum alloys were investigated. For this study, columbium was alloyed with two or more of the following: hafnium, tungsten, vanadium, titanium, and zirconium. Tantalum was alloyed with vanadium or hafnium, or hafnium and carbon. The fabricability was determined by an arbitrary procedure. Hardness measurements, elevated-temperature tensile properties, and oxidation-resistance studies were made. Of the alloys studied, Cb-15Hf-5W, Cb-15Hf-5W-10Ti, Cb-15Hf-10W-10Ti, Cb-10V-5W, Ta-30V, and Ta-20 to 33Hf exhibited excellent high-temperature properties. These alloys were not only easy to fabricate, but they also had good oxidation resistance and excellent high-temperature strength. Author

N65-11260# Massachusetts Inst. of Tech., Cambridge Metals Processing Lab.
DEFORMATION PROCESSING OF ANISOTROPIC METALS Progress Report, 1 Jul.–31 Aug. 1963
D. H. Avery and W. A. Backofen Sep. 1963 4 p refs
(Contract NOw-63-0564-d)
(PR-1; AD-424108)

Yield locus for an α-titanium alloy sheet (2.5 Sn, 5 Al) was determined experimentally. Agreements of the experimental points with equations were within 10%. Various types of specimens and associated stress ratios, (α = stress along the rolling direction/stresses along the transverse direction) are presented, along with experimental values of σ_x (stress along the rolling direction) at 0.5% effective strain and the predicted values of an isotropic material, based on the usual Mises yield criterion. From the data presented, it is concluded that for the material under consideration, the basic deformation strength is roughly 30% greater than that calculated from the more conventional Mises yield criterion. P.V.E.

N65-11283# Missouri School of Mines and Metallurgy, Rolla
SOLUBILITY OF H IN Zr AT ROOM TEMPERATURE AND PROPERTIES OF THE SOLID SOLUTIONS
M. E. Straumanis and D. H. Wiebe Aug. 1964 31 p refs
(Contract Nonr-2296(03))
(TR-9; AD-604409)

The α-ZrH_x samples were prepared from reactor grade zirconium hydride by decomposing it in a hydrogen atmosphere at various temperatures between 750° and 1000° C and by slowly cooling them to room temperature in vacuum. The solid solubility limit of H in α-Zr in such samples was 310 ppm at room temperature, determined by the parametric X-ray method. About the same solid solubility limits (280 ppm) could be derived from the increase of tensile and yield strength of Zr-wires with increasing content of H. It was found that the a-constant of pure Zr increases from a_{25} = 3.2360 to 3.2378 Å for Zr containing 310 ppm H in solid solution, and the c_{25} constant increases from 5.1508 up to 5.1572 Å, respectively. Beyond 310 ppm H both constants did not change. The thermal expansion coefficients of α-$ZrH_{0.011}$ (containing 122 ppm H) between 15 and 55° C are: $\alpha_a = 4.6 \times 10^{-6}$ and $\alpha_c = 11.0 \times 10^{-6}\,°C^{-1}$. The density of pure Zr was found to be 6.481, while the X-ray density was 6.4840 g cm^{-3} at 25° C. Author

N65-11299# Universal-Cyclops Steel Corp., Bridgeville, Pa. Refractomet Div.
HOT WORKING EVALUATION OF REFRACTORY AND REACTIVE METALS Fourth Interim Report, 1 Apr.–30 Jun. 1964
John Bonchak Jul. 1964 29 p refs
(Contract AF 33(657)-11270)
(ASD-8-170(IV); AMC-IR-8-170(IV); AD-603779)

The tendency of refractory and reactive metals to be contaminated in the InFab argon atmosphere was investigated. The results of exposures for various times, temperatures, and argon purity levels were evaluated by microhardness traverses, metallographic examination, chemical analyses, and bend tests. With due consideration to extraneous variables, and accuracy of the test methods, the results have been appraised. Author

N65-11384# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
BRIEF NOTE ON COUPLE STRESSES
J. Schijve May 1964 18 p refs Submitted for Publication
(MP-226)

Some salient aspects from recent papers of Mindlin, Koiter, and Krŏner on couple stresses are briefly discussed to evaluate the engineering importance of these stresses. Results are reported of bending tests on aluminum alloy sheet specimens to study the effect of sheet thickness on the flexural rigidity. Author

N65-11380# Technische Hochschule Aachen (W. Germany) Inst. für Allgemeine Metallkunde und Metallphysik
RECRYSTALLIZATION OF SINGLE CRYSTALS Final Technical Report
Kurt Lücke and Gerhard Ibe Sep. 1964 80 p refs
(Contract DA-91-591-EUC-2875)
(AD-451016)

Recrystallization experiments with artificial nucleation have been carried out in single crystals of high-purity aluminum, of Al-Fe-Si alloys, of Al-Mn alloys, and of high-purity silver. In all investigated cases the action of growth selection leading to preferred orientations of the recrystallized grains could be proven. By a quantitative theory of growth selection the orientation distribution of the recrystallized grains could be connected with the growth rate of the differently oriented crystals and with the number of nuclei initially available. Methods for describing orientation distributions and relationships for the case of broad orientation scattering have also been developed. They are based either on the introduction of an orientation distance derived from the pole figures or on the determination of the axes and angles of rotation that transform the recrystallized grains into the matrix. Author

N65-11383# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio TRW Electromechanical Div.
FRACTURE CHARACTERISTICS OF STRUCTURAL METALS First Quarterly Progress Report, Jan. 22–Apr. 22, 1964
M. F. Amateau, G. L. Hanna, and E. A. Steigerwald 30 Apr. 1964 74 p refs
(Contract NOw-64-0186-c)
(ER-5937; AD-604440)

A literature survey was conducted to assemble fracture toughness (K_{IC}) data for possible use in handbook form. Also, selected tests were initiated to determine the influence of specimen geometry and processing conditions on the toughness parameter. Results of a study to determine the effect of test conditions on the measurement of accurate K_{IC} values from sheet specimens are summarized. The data indicate that the initiation of slow crack growth can be categorized into three distinct types that correlate with the macroscopic fracture made of the specimens. In the temperature region where no shear failure occurred, the initiation of slow crack growth was co-incident with complete specimen failure. In the transition region, where the fracture mode contained both flat and shear areas, the onset of slow cracking was characterized by a discontinuity in the measurement of crack propagation (pop-in). At temperatures where the fracture mode was completely shear, the initiation of slow crack propagation occurred with no obvious discontinuity. Author

N65-11391# Boeing Co., Wichita, Kan. Airplane Div.
DETERMINATION OF CRITICAL CRACK LENGTH BY USE OF WEDGES
Joseph J. Horsley and Marvin Huff 23 Jul. 1964 60 p refs
(D3-6340; AD-447082)

This report describes the tests and analyses that were conducted to determine if a wedge method of crack initiation, when used in conjunction with the Griffith–Irwin equilibrium theory, would offer a simple, inexpensive method of determining critical crack lengths in materials. By using a lubricated (molybdenum disulfide) wedge and a slot tapered to match the wedge, cracks were successfully initiated in 7178-T6 and 7075-T6 plate. Attempts with 2024-T3, titanium, and steel were unsuccessful. Test results consisting of plots of initial crack length versus gross normal stress are in good general agreement with results from other tests performed by conventional methods. Author

N65-11409*# Franklin Inst., Philadelphia, Pa. Labs. for Research and Development
EFFECT OF ORIENTATION ON THE BEND FATIGUE BEHAVIOR OF BERYLLIUM Quarterly Progress Report, Jul. 22–Oct. 21, 1964
A. Lawley 5 Nov. 1964 8 p
(Contract NASr-145)
(NASA-CR-59563; Q-B2028-8) OTS Prices: HC $1.00/MF $0.50

The specific differences between the slip surface structure and the underlying dislocation substructure are being investigated in bend-fatigue beryllium crystals oriented for either basal or prism slip. The basal bend-fatigue crystal shows a uniform and relatively fine slip structure extending over the

entire central gage section. Closer to either grip, deeper slip steps occur, indicating stress concentrations at these locations. No persistent slip structures are seen below a depth of ~1μ from the original surface. The surface slip structure on prism bend-fatigue crystals is characterized by slip on both the prism and basal planes, and by the presence of a distinct brownish discoloration whose intensity increases with increasing number of cycles. The discoloration is confined to the upper and lower bend surface, through which the edge dislocations having the 1/3 [2110] Burger's vector emerge. The duplex slip structure is accompanied by fissures running across the bend surface in the [0002] direction, corresponding to the intersection of the prism plane with the bend surface. Persistent slip bands to a depth of a least 5μ were observed. Specially prepared micrographs indicate that in all cases the persistent slip bands on both the prism and basal planes correspond to intrusions. M.P.G.

N65-11429# Southwest Research Inst., San Antonio, Tex. Aerospace Propulsion Research Dept.
FUNDAMENTAL STUDIES OF CONTACT FATIGUE Progress Report No. 2, 24 Jul.-24 Oct. 1964
R. A. Burton and J. A. Russell 24 Oct. 1964 35 p refs
(Contract NOw-64-0460-d)
(RS-431; AD-450612)

Contact fatigue data are presented for several lubricants on 52100 tool steel in laboratory air, using oscillatory normal loading. Fatigue life for these experiments appears to be sensitive both to type of lubricant and to changes in stress characteristics. As far as may be determined from the preliminary data, the lubricant effects may not be similar to those in rolling contact. Preliminary hardness measurements on selected specimens have shown insignificant variation in substrate hardness for the unfailed specimens, and definite patterns of work hardening for failed specimens. Detailed statistical analysis is given for all fatigue data. Also, the technique to be applied in the calculation of stresses for near-Hertzian stress distributions is outlined. Author

N65-11431# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
LOW TEMPERATURE FLOW AND FRACTURE BEHAVIOR OF TANTALUM
John Nunes, Albert A. Anctil, and Eric B. Kula Aug. 1964 16 p refs
(AMRA-TR-64-22; AD-448479)

True-stress true-strain tension properties of commercially pure tantalum were obtained at an initial strain rate of 0.01 min^{-1} over a range of temperatures from +200° to −269° C. The flow stress, strain hardening, fracture stress, and fracture strain were determined and evaluated. Two groups of specimens were tested. One of these had a slightly higher hydrogen content (7 ppm) and exhibited a severe embrittlement between room temperature and −196° C. Also of interest was the presence of a ductility transition where the strain-hardening exponent decreased to zero and the elongation decreased sharply. Accompanying this was very little change in the reduction of area at fracture. Author

N65-11450# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
THE INFLUENCE OF THE MEAN STRESS ON THE PROPAGATION OF FATIGUE CRACKS IN ALUMINUM ALLOY SHEET
D. Broek and J. Schijve Jan. 1963 62 p refs Sponsored by Neth. Aircraft Develop. Board (NIV)
(NLR-TN-M-2111; ICAF-288)

Clad 2024-T3 and 7075-T6 sheet specimens were loaded at three different load amplitudes and three different mean loads. The mean stress had an important influence on the crack rate. The test results suggest a relation to exist of the form

$$\frac{dl}{dn} = C_1 e^{-C_2 R_s \sigma_{max}} l^{3/2}\left(1 + 10\frac{l^2}{w^2}\right).$$

The crack rate in the 7075 specimens was 3 to 4 times as large as that of the 2024 specimens. Existing crack propagation theories were checked by means of the present results. The theory of Paris gives some promise for further development. Author

N65-11461# Lehigh U., Bethlehem, Pa. Fritz Engineering Lab.
PLASTIC DESIGN IN HIGH STRENGTH STEEL: EXPERIMENTS ON HIGH STRENGTH STEEL MEMBERS Fritz Engineering Lab. Rept. No. 297.8
Peter F. Adams, Maxwell G. Lay, and Theodore V. Galambos Jul. 1964 76 p refs Sponsored by Welding Res. Council and Navy
(AD-606138)

Experimental tests complementing a theoretical review of basic structural-member behavior of high-strength steel are reported. The ultimate aim of this research is to extend this knowledge to predict the behavior of frames. The testing program performed on members of ASTM A441 steel includes basic material-property tests, beam tests under uniform moment and moment gradient, and beam-column tests. Results are presented in detail. M.P.G.

N65-11465# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CORROSION STABILITY OF LOW-CARBON AND LOW-ALLOY STEELS IN SEA WATER
G. G. Koshelev and I. L. Rozenfel'd 30 Dec. 1963 21 p ref. Transl. into ENGLISH from Tr. Inst. Fiz. Khim., Akad. Nauk SSSR (Moscow), no. 8, 1960 p 333-344
(FTD-MT-63-125; AD-605881)

Results of 6 years of tests of steels in the Barents Sea are presented. Three low-alloy steels and one carbon steel, during full submersion in the sea, corroded at approximately identical speeds, about 0.5 kg/m^2 per year. Permeability or loss of thickness of metal is 0.06 mm/year. Two of the low-alloy steels have a somewhat larger inclination to pitting than the other two steels, which corrode more evenly. The carbon steel corrodes especially evenly. The speed of corrosion of steels without scale is 5% to 10% less than that of steels with scale. Heat treatment of the carbon steel increases its corrosion resistance by 20%, but heat treatment of the other steels has no essential influence on their corrosion resistance. The loss of mechanical strength of steels (loss of ultimate strength and yield point) after 5-year tests in the sea is from 20% to 37%. D.E.W.

N65-11492# United States Steel Corp., Monroeville, Pa. Applied Research Lab.
EFFECTS OF COMPOSITION VARIATIONS ON THE PROPERTIES OF 5Ni-Cr-Mo-V STEEL
S. J. Manganello and L. F. Porter 1 Jul. 1964 20 p refs
(Contract Nobs-88540)
(AD-604867)

Four composition modifications of a 0.10% carbon 5Ni-Cr-Mo-V steel and three modifications of a 0.15% carbon 5Ni-Cr-Mo-V steel were investigated. Among the 0.10% carbon steels, the standard 5Ni-Cr-Mo-V steel and a 0.9 Mn, 0.04 Si modification exhibited the best combination of yield

strength (140 to 150 ksi) and notch toughness (80 to 120 ft-lb at 0° F). Severe embrittlement occurred when the chromium content was increased to 1.25%, and a general loss in toughness resulted when aluminum was eliminated. Increasing the carbon content of the 5Ni-Cr-Mo-V steel from 0.10% to 0.15% increased the yield strength (after appropriate tempering) from the 130 to 150 ksi range to the 150 to 165 ksi range, but decreased the notch toughness at 0° F to the 50- to 90-ft-lb range. At the higher carbon content, the notch toughness was somewhat improved when the manganese and silicon contents were reduced. Author

N65-11499*# General Electric Co., Cincinnati, Ohio Missile and Space Div.
MATERIALS FOR POTASSIUM LUBRICATED JOURNAL BEARINGS Quarterly Progress Report No. 5, Apr. 22–Jul. 22, 1964
R. G. Frank, ed. [1964] 85 p refs
(Contract NAS3-2534)
(NASA-CR-54169) OTS Prices: HC $3.00/MF $0.75

Thirteen pounds of potassium were purified, and the equipment and methods are detailed. Three separate checkout tests are reported that were performed with the isothermal-capsule corrosion test facility in the 10^{-9} torr range, and two checkout tests were conducted with the dimensional stability test facility in the same range. Checkout tests on the thermal expansion and hot hardness facilities indicate that the test environments are suitable for the evaluation of all materials in the current program. The design of the liquid-potassium friction and wear tester was reviewed extensively, and nearly all drawings were finalized. D.E.W.

N65-11515# Joint Publications Research Service, Washington, D.C.
METHODS OF INCREASING THE STRENGTH OF STRUCTURAL STEELS AND ALLOYS
L. K. Gordiyenko 2 Dec. 1964 31 p refs Transl. into ENGLISH from Tr. Inst. Metal., Akad. Nauk SSSR, no. 13, 1963 p 64–86
(JPRS-27636; TT-64-51840) OTS: $2.00

The metallurgical and physical aspects of various methods for the development of steels and steel alloys with a tensile strength of above 200 kg/mm^2 are discussed. Metastable conditions developed in the end products after the application of most of the established methods for the achievement of high strength. A purely metallurgical method is proposed to attain the required tensile strength, consisting of the special selection of compositions, alloying, and the corresponding technology of melting steel and alloys. Vacuum melting is proposed to solve the inadequate ductility and low toughness of the end products. G.G.

N65-11522# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
EFFECT OF AGING TEMPERATURE AND TIME ON THE MECHANICAL PROPERTIES OF TITANIUM ALLOY 6Al-6V-2Sn
Armando A. Iannelli and Ellsworth H. Swift Jul. 1964 14 p
(AMRA-TR-64-17; AD-606567) OTS: $0.50

A series of tests were conducted to determine the effect of aging temperature and time on the mechanical properties of titanium alloy 6Al-6V-2Sn. The aging temperatures were varied from 900° to 1100° F, and the aging time at each temperature varied from 4 to 32 hours. The solution temperatures and time were held constant. The results show that in general, as aging temperature and/or aging time increases, yield and tensile strengths decrease, while elongation, reduction of area, and Charpy V-notch impact strength increase. Author

N65-11565*# Rensselaer Polytechnic Inst., Troy, N.Y.
[INTERDISCIPLINARY MATERIALS RESEARCH INCLUDING FUNDAMENTAL PHYSICS AND CHEMISTRY OF MATERIALS, ENVIRONMENTAL EFFECTS AND RELATED PROBLEMS] Semi-Annual Progress Report, Mar. 1–Aug. 31, 1964
Sep. 1964 24 p refs
(Grant NsG-100-60)
(NASA-CR-59605) OTS Prices: HC $1.00/MF $0.50

The following topics are discussed: "Mechanical Properties of Polymers"—the fracture of polymers, the polymer network mechanics, the viscoelastic properties of the polymers, and the high-pressure infrared spectra; "A Study of the Interaction of Dislocations with the Discrete Second-Phase Particles in Dispersion-Strengthened Alloys"—the recovery and recrystallization kinetics in two-phase systems, the work-hardening behavior in precipitation-hardened alloys, and the fracture behavior; "Mechanism of Solidification"—ultrasonic research, the ultrasonic pulse interferometry, and the excited molecules; "The Relation of Molecular Structure and Intermolecular Action in Flow of Polymers and Polymer Dispersions as a Function of Temperature and Shear Rate"—high-temperature and mechanical metallurgy, high-temperature studies of cobalt and cobalt-base alloys, and experimental X-ray stress-analysis procedures for ultra-high-strength materials; "Low Temperature Physics"; "Ceramics Research"; "X-Ray Scattering"; and "Spectroscopic Studies of Synthetic Reversible Oxygen-Carrying Chelates." G.G.

N65-11570# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
EVAPORATION OF IRON-, NICKEL-, AND COBALT-BASE ALLOYS AT 760 TO 980° C IN HIGH VACUUMS
D. T. Bourgette Nov. 1964 39 p refs
(Contract W-7405-ENG-26)
(ORNL-3677)

Evaporation losses increased with chromium and manganese concentration and temperature but were independent of pressure in the range investigated. The data have also shown that, at constant temperature, the evaporation rates decreased with time and that the lower the test temperature, the greater the decrease in the rate. Metallographically, the manifestations of evaporation were subsurface void formation, grain growth at the specimen surface, excessive void formation in the grain boundaries, disappearance of precipitated phases, and materials loss from the edges of surface grains. Chemically, chromium and manganese were found to be the principal elements lost. At test temperatures of 872° and 982° C, it was found that a thin film of Cr_2O_3 (the most stable oxide studied) retarded the evaporation of the base alloy; however, the protection was not permanent. After approximately 1000 to 3000 hr, the evaporation rates for both the oxidized and polished surfaces of type 316 stainless steel were nearly equal. Author

N65-11571# Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
DENSITY DETERMINATIONS OF PLUTONIUM
R. D. Nelson, C. R. Becker, T. K. Bierlein, and F. E. Bowman Feb. 1964 25 p refs
(Contract AT(45-1)-1350)
(HW-80841) OTS: $0.75

Precise densities of plutonium can be readily obtained between −100° and 150° C using inert fluorochemicals as the displacement medium. Relatively precise densities can be obtained between 150° and 250° C with a silicone fluid as a displacement medium in an inert atmosphere. A detailed procedure for routine density determinations with Invar and gold as the known standards is discussed. Changes in the density

of plutonium with time prohibit the use of a plutonium standard in the determination of densities of unknown plutonium specimens. Author

N65-11597# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE MECHANICAL PROPERTIES OF SOME INTERMETALLIC COMPOUNDS AND PHASES
E. M. Savitskiy 7 Apr. 1964 20 p refs Transl. into ENGLISH from Izv. Sektor. Fiz.-Khim. Analiza, Inst. Obshch. Neogran. Khim., Akad. Nauk SSSR (USSR), no. 19, 1949 p 419–428
(FTD-MT-63-260; AD-605886)

This is a study of alloys of the systems Mg-Zn, Al-Mg, and Cu-Zn (up to 50% Zn). The initial materials were electrolytic magnesium, zinc, copper, and technical aluminum. The measured mechanical properties of a series of pure intermetallic phases at different temperatures are presented in composition diagrams depicting hardness, outflow pressure, capacity for deposition, etc. A new phase in the middle part of the system Al-Mg was established by a detailed investigation of structure and properties. G.G.

N65-11602# Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
METALWORKING Review of Recent Developments
T. G. Byrer, J. H. Gehrke, and F. W. Boulger 3 Jul. 1964 4 p refs
(AD-605861)

Hydrostatic extrusions of steel, titanium, and aluminum under fluid pressure have been investigated. The maximum extrusion ratios for the various conical dies and tee sections are presented, as well as the optimum pressure fluid media and the lubricants used for each extrusion. A new forging technique is described that employs hydrostatic back pressure for lowering the tensile stresses during forming of metals. Resonant frequencies of 20 to 26 000 cps were applied to tension and compression test specimens of aluminum and steel in the plastic range, and load reductions were obtained in all cases. A new rolling process was developed in which the metal was bent plastically around a small floating roll, and thus resulted in reduced roll-force requirements and increased mill capacity. A new process for axial-load bulge forming is also presented. G.G.

N65-11605# ManLabs, Inc., Cambridge, Mass.
MECHANICAL BEHAVIOR OF INTERMETALLIC COMPOUNDS Technical Documentary Report, 15 Oct. 1962–14 Sep. 1963
L. E. Tanner, J. J. Ryan, I. Vilks, and S. V. Radcliffe Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1963 122 p refs
(Contract AF 33(657)-7432)
(ASD-TDR-62-1087, Pt. II; AD-602533)

Specimens taken from extrusions of the intermetallic compounds VNi_3, VNi_2, and VCo_3, of stoichiometric composition, were given a series of heat treatments to develop varying degrees of order. Mechanical properties of these specimens were determined at room temperature by means of compression and hardness testing. Structural examinations of these three compounds were started, and X-ray diffraction, light microscopy, and transmission electron microscopy provided some initial insight into their transformation behavior. The structural dependence of mechanical behavior has been reviewed. In addition, preliminary work with off-stoichiometric compositions of VNi_3, VNi_2, and VCo_3 and with stoichiometric V_2Ni, V_3Ni, VCo, and V_3Co have been carried out. Author

N65-11650# Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
OXIDATION-RESISTANT COATINGS FOR REFRACTORY METALS Review of Recent Developments
J. J. English 17 Jul. 1964 2 p refs
(AD-605866)

Columbium alloys that were coated with Ag-Si-Al slurry silicide showed excellent oxidation protection with coating lives of 68 to 95 hours and 95-percent reliability at 2600° F. The formation of stable oxidation products in the oxidation of $MoSi_2$ was found to depend primarily on the pressure and on the foregoing sequence of the oxidation process. Also investigated were the limitations imposed by diffusion on the protection of tungsten from oxygen at 2000° C and above. G.G.

N65-11676# Allegheny Ludlum Steel Corp., Brackenridge, Pa. Research Center
TANTALUM ALLOY TUBING DEVELOPMENT PROGRAM Fourth Interim Technical Engineering Report, 15 Apr.–15 Jul. 1964
F. S. Turner Wright-Patterson AFB, Ohio, Res. and Technol. Div., Aug. 1964 29 p refs
(Contract AF 33(657)-11261)
(RTD-TR-8-109(IV); AD-606516)

Data obtained from the initial breakdown extrusion of the T-222 alloy are presented. The extrusion to 2.060-inch o.d. by 1.440-inch i.d. tube hollow of both the Ta-10W and T-222 alloys has been achieved from a 5-inch liner on a 2200-ton press. Extrusion data and photographs of the tube hollows in the as-extruded condition are presented. The T-222 alloy proved to be the stiffer and more difficult to extrude. Author

N65-11681# Wah Chang Corp., Albany, Ore.
TUNGSTEN EXTRUSION DEVELOPMENT PROGRAM Final Technical Documentary Report, 2 Dec. 1960–27 Jun. 1963
A. E. Riesen, C. T. Wang, and S. A. Worcester Wright-Patterson AFB, Ohio, AF Mater. Lab. [1963] 153 p refs
(Contract AF 33(600)-42395)
(ML-TDR-64-217; AD-605195)

Procedures were developed for preparation of tungsten–3% molybdenum extrusion billets by arc casting and by pressing and sintering. Round extrusions were made to evaluate die lubrication and die coatings in temperatures ranging from 3200° to 4000° F at reduction ratios as high as 17:1. Efforts to meet program target dimensional and surface requirements with arc cast tungsten–3% molybdenum were unsuccessful. However, extruded tungsten T-sections up to 138 in. long having surface finishes better than 100 rms and dimensional run-out within 0.010 in. were successfully produced from pressed and sintered starting material. The extrusion conditions necessary to achieve the program target dimensions resulted in a hot-worked microstructure that has a high ductile–brittle transition temperature and relatively low strength. Author

N65-11725# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROPERTIES AND APPLICATION OF HALF-FINISHED PRODUCTS FROM SINTERED ALUMINUM POWDER (SAP)
B. L. Matveev, I. N. Fridlyander, G. D. Agarkov, M. G. Stepanova, and P. T. Vlasova *In its* Aluminum Alloys 25 Aug. 1964 p 3–11 (See N65-11724 02-15)

Different methods of working sintered aluminum powder (SAP) are described to show that the existing idea of the fragility of sintered materials does not apply to SAP. The material is processed by the same methods as the hardening aluminum alloys, and heat treatment is not required. The mechanical properties of pressed, rolled, and stamped

semifinished products from SAP-1 and SAP-2 (rods, pipes, strips, sheets, rivet wire, and foil) are tabulated for the temperature range from 20° to 600° C. The prolonged strength of both alloys is practically identical, and exceeds the strength of all the aluminum deformed alloys. M.P.G.

N65-11726# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INVESTIGATION OF THE STRUCTURE OF SAP

I. N. Fridlyander, M. G. Stepanova, N. S. Gerchikova, and N. I. Kolobnev *In its* Aluminum Alloys 25 Aug. 1964 p 12–23 (See N65-11724 02-15)

The possibility of improving the mechanical properties of sintered aluminum powder (SAP) exists because, unlike other dispersion-hardening alloys, the limit of alloying is not related to the limit of solubility of the second phase. Based on a review of the literature and experimental results, the following is concluded: (1) The structure of SAP constitutes an aluminum matrix with embedded dispersed particles of the oxide phase. (2) With an increase of aluminum oxide content, the quantity of particles of the oxidized phase increases and the distance between them decreases. (3) Properties of semifinished products from SAP depend on the distance between the particles of aluminum oxide. (4) The dimension, quantity, and distance between oxidized phase particles in sheet material from SAP do not depend on the degree of deformation; however, the ultimate strength of SAP sheets at room temperature is increased with an increase in the degree of cold deformation. This is probably explained by work hardening of the aluminum matrix and formation of texture. M.P.G.

N65-11730# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INFLUENCE OF HEATING OF ALUMINUM POWDER BEFORE BRIQUETTING ON MECHANICAL PROPERTIES OF PRESSED HALF-FINISHED PRODUCTS

P. V. Kishnev, E. A. Kuznetsov, and P. T. Vlasova *In its* Aluminum Alloys 25 Aug. 1964 p 44–52 (See N65-11724 02-15)

Sources of gas in aluminum powder include oils from the ball-milling process and moisture due the hydroscopicity of Al_2O_3. These gases are the cause of swelling, bubbles, and stratification in semifinished products fabricated from SAP briquettes. A study of eliminating the gas sources by heating the powder before briquetting indicates that maximum degassing occurs when the powder is held at 600° C for 5 hours. The results also indicate that heating of the powder up to 500° C does not affect the mechanical properties of the semifinished product, but increase of temperature to 600° C leads to lowering of ultimate strength and to increased elongation. A monolithic high-quality briquette with a density of 2.5 to 2.7 kg/cm^3 is obtained from the heated powder. Therefore, the precompacting operation, necessary during cold briquetting, can be eliminated from the pressing process. M.P.G.

N65-11732# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INFLUENCE OF DEGREE OF DEFORMATION, SPEED AND TEMPERATURE OF PRESSING ON MECHANICAL PROPERTIES OF PRESSED HALF-FINISHED PRODUCTS

P. V. Kishnev, B. I. Matveev, V. S. Zolotov, and L. S. Perevyazkin *In its* Aluminum Alloys 25 Aug. 1964 p 63–69 (See N65-11724 02-15)

Investigations of the influence of the degree of deformation, speed, and temperature of pressing on the mechanical properties of SAP semifinished products were conducted under factory conditions on existing equipment. Results reported indicate the following: (1) Increase of the degree of deformation during pressing of rods up to 85% increases ultimate strength and elongation; above 85% the strength is unchanged. (2) Speed of pressing does not influence the mechanical properties of pressed half-finished products, but does influence surface quality. (3) Temperature increases from 450° to 500° C do not affect the mechanical properties of semifinished products, but heating above 500° C insignificantly lowers ultimate strength and increases elongation. (4) Optimum conditions for obtaining high-quality, pressed, semifinished products include degree of deformation not below 85%, pressing speeds not below 8m/min, heating of stock to 450° to 500° C, and preheating the aluminum powder to 500° to 550° C for not less than 2 to 3 hours before briquetting. M.P.G.

N65-11735# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

PROPERTIES AND STRUCTURE OF WIRE FROM SAP

P. V. Kishnev, B. I. Matveev, N. A. Martynova, S. L. Nomofilov, E. Ya. Bazurina et al *In its* Aluminum Alloys 25 Aug. 1964 p 86–94 (See N65-11724 02-15)

The manufacture of wire from sintered aluminum powder (SAP) is described, and the mechanical properties and structure of the resulting wire are reported. Rivets made from this wire were also tested. It was found that wire of smaller diameters has, at room temperature, higher strength and lower elongation than wire of large diameter. Pressed-wire stock of 6-mm diameter and calibrated wire of smaller diameters made from brand APS-1 powder containing more than 7% Al_2O_3 is not useful for manufacturing rivets, due to cracks on the heads. Annealing of wire lowers the ultimate strength and increases plasticity. A lot of rivets prepared from wire manufactured from PP-4 powder was of high quality and performed satisfactorily in the riveting of a connecting seam. M.P.G.

N65-11739# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

MECHANICAL PROPERTIES AND STRUCTURE OF FORCED BILLETS FROM SAP

P. V. Kishnev, L. S. Perevyazkin, A. A. Petrova, and N. N. Averkina *In its* Aluminum Alloys 25 Aug. 1964 p 117–123 (See N65-11724 02-15)

Optimum conditions for forging billets obtained from pressed rods of sintered aluminum powder (SAP) were investigated. The results show the possibility of forging billets by using existing factory equipment. The best combination of strength and elongation was obtained at an initial forging temperature of 550° C and termination temperature of 360° C. The method of briquetting of the aluminum powder was found to have no effect on mechanical properties of pressed rods and forged plates. M.P.G.

N65-11742# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ANISOTROPY OF PROPERTIES OF SAP DURING HOT ROLLING

V. A. Shalamov and F. V. Zhuravlev *In its* Aluminum Alloys 25 Aug. 1964 p 148–153 (See N65-11724 02-15)

The influence of annealing of stock and of the direction of rolling on uniformity of the distribution of mechanical properties in hot-rolled sintered aluminum powder (SAP) was studied. Results indicate the following: (1) Ultimate strength and yield, elongation, and narrowing are higher for transverse samples than for longitudinal samples. (2) The direction of rolling does not affect the change in material properties with degree of deformation. (3) The change in properties with an increase of total deformation is more uniform in preannealed

than in unannealed samples. (4) Tensile tests of microsamples reveal almost no yield areas. (5) The material structure is uniform and stable; however, a tendency to texture formation is noted with increase in total reduction. M.P.G.

N65-11745# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

STRUCTURE AND PROPERTIES OF WELDED JOINTS OF WELDABLE SAP

M. V. Poplavko and I. N. Gerasimenko *In its* Aluminum Alloys 25 Aug. 1964 p 169-176 (See N65-11724 02-15)

Tests of sintered aluminum powder (SAP) joints indicate that the strength of welds cut across the direction of rolling is greater than it is in the longitudinal direction. Failure occurs in the basic material in the heat-affected zone near the weld. It was also established that SAP welds without cracks. Comparatively strong seams were obtained with B40 filler wire, but special technology is required for obtaining hermetically welded joints. M.P.G.

N65-11747# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SAS WITH LOW COEFFICIENT OF LINEAR EXPANSION

I. N. Fridlyander, N. S. Klyagin, and R. A. Krivenko *In its* Aluminum Alloys 25 Aug. 1964 p 185-195 (See N65-11724 02-15)

Sintered aluminum alloys (SAS) of the system Al-Si alloyed with different elements having a comparatively low coefficient of linear expansion were investigated. The initial powders were obtained either by atomization, using a spray installation or by crushing of alloy shavings on a ball mill, followed by hot briquetting and pressing. Tests of mechanical and physical properties of the finished rods showed the following: (1) Alloys closest in composition to eutectic silium have the highest strength. (2) Plasticity decreases with content of silicon. (3) Addition of nickel affects the properties of the alloy more favorably than iron. (4) Alloys obtained by atomization exhibit sharply increased strength in comparison with those prepared by usual methods. (5) The microstructure of powder alloys with additions of Zr, Ti, and SiC is analogous to the microstructure of the alloys with Fe and Ni. M.P.G.

N65-11753# Lexington Labs., Inc., Cambridge, Mass.

THERMAL RADIATION CHARACTERISTICS OF TRANSPARENT SEMI-TRANSPARENT AND TRANSLUCENT MATERIALS UNDER NONISOTHERMAL CONDITIONS

Robert C. Folweiler and William J. Mallio Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 148 p refs
(Contract AF 33(657)-11280)
(ASD-TDR-62-719, Pt. II; AD-607742)

The emissivity values of Al_2O_3, MgO, SiO_2, and $SrTiO_3$ were calculated from appropriate reflectivities, absorption coefficients, and scattering coefficients derived from material characteristics. At wavelength shorter than about 6 microns, the absorption coefficient is so slow that emissivity is a volume process that is strongly affected by the absorption coefficient and scattering coefficient of the oxide. Experimental emission measurements for the oxides at temperatures up to 1200° C and at wavelengths from 1 to 15 microns showed good agreement with the calculated values for Al_2O_3 and SiO_2. In the calculation of hemispherical emissivity of oxide materials at temperatures above 1000° C, the Hamaker equation was used to find a satisfactory approximation to the exact equation. It was found that the effective emissivity depends on the temperature gradients within the body, as well as on the surface temperature itself. G.G.

N65-11764# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.

MECHANICAL BEHAVIOR OF NORMALIZED COLD-DRAWN AISI 4340 STEEL UNDER BIAXIAL STRESS AND RAPID HEATING

C. W. Austin, Jr. 16 Jul. 1964 65 p refs
(RR-TR-64-13; AD-606218)

This report presents a description of test apparatus and experimental procedures for the determination of the biaxial deformation behavior of metallic materials under rapid heating conditions. The results of tests on tubular test specimens of normalized cold-drawn AISI 4340 steel subjected to uniaxial tension and to tension-tension (axial:tangential) biaxial stress ratios of 2:1, 1:1, and 1:2 are given. In general, increasing the heating rate delays specific amounts of plastic deformation to higher temperatures for biaxial stress ratios of 1:0, 1:1, and 1:2, but has little influence on the temperatures at which plastic deformation occurs for the 2:1 biaxial stress ratio. The deformation behavior for the 1:1 and 1:2 stress ratios may be predicted from uniaxial test data for plastic strains up to 2 percent whereas that for the 2:1 biaxial stress ratio may be predicted only for plastic strains of less than 0.5 percent. Author

N65-11766# Wisconsin U., Madison Mathematics Research Center

REMARKS ON THE EXTREME EIGENVALUES OF TOEPLITZ FORMS ASSOCIATED WITH ORTHOGONAL POLYNOMIALS

Seymour V. Parter Aug. 1964 27 p refs
(Contract DA-11-022-ORD-2059)
(MRC-498; AD-607808)

The extreme eigenvalues of the truncated Toeplitz matrices associated with certain orthogonal polynomials are studied. Certain comparison theorems enable one to extend the results of Hirschman for the classical orthogonal polynomials. Author

N65-11779# Naval Research Lab., Washington, D.C. Metallurgy Div.

NEW INFORMATION ON NEUTRON EMBRITTLEMENT AND EMBRITTLEMENT RELIEF OF REACTOR PRESSURE VESSEL STEELS

L. E. Steele and J. R. Hawthorne 6 Oct. 1964 35 p refs
(NRL-6160; AD-607494) OTS: $1.00

Neutron embrittlement of the carbon and low-alloy steels investigated has been defined in terms of increases in the nil ductility transition (NDT) temperature. Increases in the NDT of pressure vessel steels as great as 545° F have been observed. The extent of embrittlement has been shown to depend upon the neutron exposure ($n/cm^2 > 1$ MeV), the type of steel, and the irradiation temperature. Embrittlement relief through annealing heat treatment at temperatures above the pressure vessel operating temperature has been demonstrated. Significant embrittlement relief was observed even with multiple irradiation-annealing cycles, the extent of relief being primarily dependent upon the irradiation temperature and the subsequent annealing temperature. Experimental data are reviewed with consideration for application to operating nuclear pressure vessel conditions. Author

N65-11784# Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center

REPORT ON THE FOURTH MARAGING-STEEL PROJECT REVIEW

A. M. Hall and J. E. Campbell 19 Aug. 1964 26 p refs
(Contract AF 33(615)-1121)
(DMIC-MEMO-196; AD-605716)

Reviewed are the mechanical properties of maraging steels, general maraging-steel evaluations, mechanical properties of welds and fabrication of 18%-nickel maraging steels, fabrication and characteristics of maraging steels, and alternate motor-case materials. Considerable effort has been expended to resolve certain technical problems relating primarily to 18%-nickel maraging-steel plate, which has been under consideration for large booster cases. Among these problems have been banding and the resultant low short-transverse mechanical properties, low fracture toughness of welds, and variations in mechanical properties, associated with mill processing variables. Author

N65-11797# Super-Temp Corp., Santa Fe Springs, Calif.
A COMPARATIVE EVALUATION OF THE FORMABILITY OF TUNGSTEN PLATE AND SHEET BY SPINNING TECHNIQUES Quarterly Report, 1 Jan.–31 Jul. 1964
D. W. Bauer 15 Aug. 1964 30 p refs
(Contract NOw-63-0542-c)
(QR-3; AD-606735)

Physical and mechanical properties on the "as received" sheet and plate stock, shear spinnability data on 0.250-in. tungsten plate, shear spinning uniformity data, and form spinning uniformity data on 0.060-in. tungsten sheet and 0.250-in. tungsten plate are reported. Author

N65-11808# IIT Research Inst., Chicago, Ill.
INTERFACE FRICTION IN HOT METAL DEFORMATION First Bimonthly Progress Report, May 23–Jul. 23, 1964
John A. Schey 22 Aug. 1964 6 p
(Contract NOw-64-0458-f)
(IITRI-B6027-1; AD-604437)

Preliminary work on requirements for the experimental technique is reported. Requirements are stated for the generation of new surfaces at a high rate, for large plastic deformations, for independently variable temperatures of the die and the workpiece, for a relatively simple stress system, and for a controllable atmosphere during preheating and deformation. The only method of test fulfilling these requirements is that of plane-strain compression. Test-sheet thickness, area of test, and other parameters were set up; a die set with heated anvils was designed and manufactured; and instrumentation is being designed, fabricated, and applied to the die set for the obtaining of accurate measurements. D.E.W.

N65-11838# General Dynamics/Fort Worth, Tex.
BIAXIAL STRESS CONSIDERATIONS OF A BRITTLE DIELECTRIC MATERIAL
J. E. Burroughs and H. R. Thornton *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. II [1964] 21 p refs (See N65-11832 02-07)

Design of a structural component utilizing brittle materials, namely ceramics, requires a rigid definition of the mechanical properties. Available mechanical property data are not adequate as critical design criteria. The fracture strength is a structure-sensitive property, and thus provides a basic parameter for study of the peculiar traits exhibited by brittle materials. Most available information indicates that the bending strength of these brittle materials is, to some extent, dependent upon a size–shape factor. This treatise reports two methods of obtaining structural data; namely, behavior under a uniaxial stress caused by beam bending with variations in span length and thickness, and behavior under a biaxial stress caused by concentrated transverse loading of a simply supported square plate. Theoretical considerations and test results are reported for Pyroceram 9606. Author

N65-11845# General Dynamics/Pomona, Calif.
RAIN EROSION RESISTANCE OF SLIP CAST FUSED SILICA RADOMES
R. L. Hallse and R. A. Fortain *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. IV [1964] 27 p (See N65-11843 02-07)
(Contract NOw-62-1087)

Slip-cast fused silica will erode without undergoing catastrophic failure. Glazing improves the rain erosion resistance of pointed slip-cast fused silica radomes. The erosion rate is affected greatly by specimen geometry, with pointed radomes showing the least erosion. Erosion can be minimized by the use of a small metal or dense ceramic tip. Slip-cast fused silica has sufficient strength to withstand the vibration, accelerations, and acoustics of a missile flight and launch. Author

N65-11875# Watervliet Arsenal, N.Y. Benét R & E Labs.
EVALUATION OF THE PRECRACKED CHARPY TEST AS A METHOD OF DETERMINING FRACTURE TOUGHNESS OF HIGH STRENGTH STEEL ALLOYS
Keh Chang Wu and Vito J. Colangelo Jul. 1964 28 p refs
(WVT-ID-6413; AD-606664)

Precracked Charpy-test specimens were prepared from three consumable electrode melted high-strength sheet alloys: AISI 4340, Ladish D6AC, and Unimach II. These specimens were subjected to various austenitizing and tempering conditions and tested at 78° and −40° F. Fracture toughness of these steels, as determined by this method, was compared at various strength levels. Author

N65-11891# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.
THE INFLUENCE OF ALLOYING ELEMENTS ON THE Ti-6Al-6V-2Sn ALLOY
Arthur Ayvazian, Robert Colton, and Perry Smoot Aug. 1964 46 p refs
(AMRA-TR-64-15; AD-607404)

An investigation was conducted on eight promising, high-strength titanium alloys that had as their basic composition Ti-6Al-6V-2Sn. Small percentages of beta-stabilizing elements, such as Cr, Mo, Mn, Ni, and U in various combinations, along with a maximum of 4% Zr, were added. The series of studies consisted of determining the beta transus temperature, determining proper forging temperatures, and establishing a thermal cycle, which would result in optimum mechanical properties. The results of standard tensile and V-notch Charpy impact test bars machined from upset billets that were forged and heat treated at optimum investigated temperatures, indicated a general increase in the tensile and yield strength when compared with the base alloy, Ti-6Al-6V-2Sn. The overall improvements in strength ranged from a substantial increase of approximately 15 000 psi in both yield and tensile strengths at 0.1% offset for several of the alloys, to an increase of from 0 to 8000 psi for the remainder of the alloys. Author

N65-11977# Experimental Inst. of Light Metals, Milan (Italy)
STRUCTURAL AND MECHANICAL PROPERTIES AND STRESS-CORROSION RESISTANCE OF WROUGHT COMPLEX ALLOYS OF THE Al-Zn-Mg-Cu SYSTEM WITH DEFINED AMOUNTS OF CHROMIUM, ZIRCONIUM AND SILVER Final Technical Status Report, 1 Jul. 1962–31 Jul. 1964
E. Di Russo [1964] 115 p refs *Its* Rept.- 13.719/6407.069
(Contract DA-91-591-EUC-2464)
(AD-448088)

Experimental results obtained were carried out on wrought complex Al-Zn-Mg-Cu alloys of the type 7075, containing

one of following additions: (1) 0.20% Cr; (2) 0.20% Cr and 0.15% Ag; (3) 0.20% Cr and 0.30% Ag; (4) 0.20% Zr; or (5) 0.20% Zr and 0.30% Ag. The structural and tensile properties of the alloys in different wrought and heat-treated conditions and the stress-corrosion resistance of the alloys aged in the range 125° to 175° C were examined. Results have indicated that a significant improvement of the stress-corrosion behavior of the 7075 alloy containing Cr or Zr can be attained by adding 0.30% Ag and then aging it at temperatures higher than 125° C. D.S.G.

N65-11990# Naval Ordnance Lab., White Oak, Md.
THE EFFECT OF PRESSURE ON MARTENSITIC REACTIONS IN LOW ALLOY STEELS
R. E. Predmore Oct. 1964 58 p refs
(NOLTR-64-105; AD-447576)

The depression of the martensitic start temperature of 43XX steel by pressure was measured from cooling curves. A 3/4-inch, supported piston pressure vessel was used for the measurements. The martensitic start temperatures were predicted from the thermodynamic data. Photomicrographs showed that martensite formed in 43XX steel at high pressure was finer than normal martensite. The hardness of high pressure martensite is much greater than normal martensite.
Author

N65-12000# ManLabs, Inc., Cambridge, Mass.
THE THERMODYNAMIC PROPERTIES OF α, F.C.C., NICKEL-ZINC ALLOYS
Edward V. Clougherty and Larry Kaufman 1 Feb. 1963 28 p refs
(Contract Nori-2600(00))
(TR-6; AD-298111)

The thermodynamic properties of solid nickel–zinc alloys in the α, fcc, phase were obtained from vapor-pressure data measured by the dew point method in the range 900° to 1100° C. The system displays negative deviations from ideality. At 1200° K for $x_{Zn}=0.2798$, $F_E^{\alpha}+x\,\Delta F_{Zn}^{L\rightarrow\alpha}$ is -2382 cal/mole; $H_E^{\alpha}+\Delta H_{Zn}^{L\rightarrow\alpha}$ is -5158 cal/mole; and $S_E^{\alpha}+x\,\Delta S_{Zn}^{L\rightarrow\alpha}$ is -2.24 cal/mole ° K. The measured negative excess entropy of the α phase at high temperatures is discussed in terms of the calculated magnetic entropy based on saturation magnetization data for the alloys and the vibrational entropy based on Debye temperatures from temperature-dependent X-ray intensity data. The specific heat of three fcc alloys was measured from 1.4° to 4.0° K. Some limitations of the electronic specific coefficient γ and the Debye temperatures derived from the latter measurements are presented. Author

N65-12016*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio TRW Electromechanical Div.
GENERATION OF LONG TIME CREEP DATA OF REFRACTORY ALLOYS AT ELEVATED TEMPERATURES Fifth Quarterly Report, 26 Jun.–26 Sep. 1964
J. C. Sawyer and C. H. Philleo 9 Nov. 1964 27 p
(Contract NAS3-2545)
(NASA-CR-54228) OTS Prices: HC $2.00/MF $0.50

Twelve of the 14 ultrahigh-vacuum creep furnaces and the central control console are now being installed, and two of these units have been placed in operation. Creep data are presented for FS-85 columbium alloy at 2000° F, 7000 psi and for tungsten-25% rhenium alloy at 3200° F, 5000 psi. Various problems affecting the 1000- and 10 000-hour reliability of the system have been encountered. These problems and the corrective measures taken are described. Author

N65-12028# IIT Research Inst., Chicago, Ill.
YIELDING IN POLYCRYSTALLINE METALS Interim Technical Report, 16 Nov. 1962–15 Nov. 1963
W. Rostoker and W. Brentnall Wright-Patterson AFB, Ohio ARL, Oct. 1964 31 p refs
(Contract AF 33(657)-7650)
(ARL-63-245, Pt. II; AD-608450)

Microyield, as revealed by etch-pit techniques, shows slip activity well below strains of 10^{-6}. The grain-size dependencies of microyield as defined by microextensometer measurements and by etch-pit studies are essentially the same for the two methods as applied to Ni, Fe, and Fe-3% Si. The microyield of Fe is independent of grain size; it is shown that this is probably due to generation of active dislocations at inclusions that were very populous in this material. The microyield of Fe-3% Si and Ni are very much dependent on grain size, following the $d^{-1/2}$ function as at higher strain levels. Slip in Fe does not reveal itself as well-defined slip lines, but as apparently uncoordinated multiplication of dislocations. Slip in Fe-3% Si and in Ni appears as well-defined slip lines and bands. Evidence is presented to show that dislocation sources in Fe-3% Si are primarily at grain surfaces. Author

N65-12062# Franklin Inst., Philadelphia, Pa. Research and Development Labs.
THE FLOW AND FRACTURE OF ZONE REFINED TUNGSTEN Final Report
G. J. London Apr. 1964 32 p refs
(Contract DA-36-034-ORD-3747-RD)
(F-B1973; WAL-TR-834.2/11-3; AD-605805)

This report covers the first efforts toward purification of tungsten by induction floating-zone melting. The difficulties encountered in initial melting efforts were poor visibility and inadequate zone length control. The former was overcome by using a preliminary solid-state vacuum outgassing treatment. The latter difficulty was partly solved with the use of a levitation-type, melting coil to support the molten zone. Tensile specimens were prepared by spark and chemical machining techniques. Specimens were tested with three electron-beam-zone passes, one induction-zone pass, and three electron-beam followed by four induction-zone passes. The critical resolved shear stresses decreased in the order listed above, with the one induction-zone pass material showing lower CRSS than the three electron-beam-zone pass material. Author

N65-12077*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
A STUDY OF OXIDATION KINETICS OF NICKEL METAL IN FLOWING AIR AND OXYGEN-NITROGEN MIXTURES
D. J. Progar and B. W. Lewis Washington, NASA, Dec. 1964 56 p refs
(NASA-TN-D-2224) OTS Prices: HC $1.50/MF $0.50

A study was made of the oxidation kinetics of nickel metal sheet in flowing air and in oxygen–nitrogen mixtures of varying composition. The study covered the temperatures 1500°, 1750°, 2000°, 2250°, and 2500° F and covered flow conditions of natural convection and 0.065, 0.130, 0.205, and 0.280 standard ft^3/min for the air study and 0.130 and 0.280 standard ft^3/min for the oxygen–nitrogen mixture study. The oxygen partial pressures of the gas mixtures used were 380-, 76-, 38-, and 7.6-mm mercury. A thermogravimetric technique was used to obtain the rate data. The data showed the reaction in the thick-film region to follow a parabolic-rate-law characteristic of a mechanism in which diffusion through a crystalline solid is rate controlling. The reaction-rate constants and energy of activation obtained agree reasonably well with most other experiments in the literature in which there was no forced flow of gas. Author

N65-12096 IIT Research Inst., Chicago, Ill.
FIBER-REINFORCED METALS AND ALLOYS Fourth Bimonthly Report, 8 May–8 Jul. 1964
N. M. Parikh 14 Aug. 1964 7 p
(Contract NOw-64-0066-c)
(IITRI-B6020-4; AD-604190)

Current studies are reported on the mechanisms of strengthening and deformation and the fracture behavior of composites of tungsten–silver and steel–silver, with both short alined fibers as well as long continuous fibers. Results indicate that with short discontinuous alined fibers in a composite, only a fraction of the fiber strength is realized. The concentration of fibers at which the strength of the composite levels off depends upon the fiber diameter. The ductile–brittle transition found in silver–steel composites was also found in tungsten–silver composites. The fracture mode, whether matrix failure or fiber failure, appears to be related to the degree of strengthening available. D.S.G.

N65-12101# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
X-RAY INVESTIGATION OF DOUBLE VANADIUM-TUNGSTEN CARBIDES
M. A. Gurevich and B. F. Ormont 27 Aug. 1964 13 p refs
Transl. into ENGLISH from Metalloved. i Obrabotka Metal (USSR), no. 1, 1958 p 7–10
(FTD-MT-64-100; AD-605732) OTS: $1.00

At 1700° to 1800° C the cubic carbide of vanadium, VC, dissolves nearly ten mol percent of the hexagonal carbide, WC. At 2150° to 2200° C the vanadium carbide dissolves more than fifty mol percent of the tungsten carbide; a single-phase system is formed on the VC base. This single-phase system is a continuous row of solid solutions with a smoothly variable period of identity from 4.16 to 4.21 kX along a very steep curve. The period of the identity lattice of the WC phase decreases by 3 to 4 units in the third decimal place. This can be explained probably by the very small solubility of the cubic VC in the hexagonal WC. D.E.W.

N65-12110# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.
INVESTIGATION OF ANTIMONY COATINGS, CYCLIC OXIDATION-CORROSION ENVIRONMENT Final Report
E. Taylor 22 Nov. 1963 5 p
(NAEC-AML-1819; AD-424104)

A study was made of the protective properties of antimony when plated on steel and coupled to magnesium. Steel cleats, plated with either antimony or aluminum, were riveted to magnesium alloy panels and exposed to 600° F for 16 hours, followed by exposure in a salt-spray cabinet. Each phase was photographed and observed for corrosion signs. It was found that the aluminum-plated panels with a 52.6% corrosion showed a somewhat greater resistance than the antimony-plated steel panels with 62.2% corrosion. G.G.

N65-12137# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
EVALUATION OF REFRACTORY METAL SHEET ALLOYS
George E. Gazza and Thomas S. De Sisto Jul. 1964 29 p
(AMRA-TR-64-16; AD-608164) OTS: $0.50

Five columbium-base alloys, three tantalum-base alloys, and two molybdenum-base alloys were evaluated. Mechanical properties were determined by tensile testing at room temperature and at elevated temperatures, by stress rupture testing, and by bend testing of base-metal specimens and welded specimens. The properties of the alloys are compared with target requirements. Significant progress in refractory-metal sheet development is demonstrated by a comparison of the test data with target properties. In general, the properties of the alloys approached or exceeded the target requirements. Author

N65-12151# Rocketdyne, Canoga Park, Calif. Research Dept.
STRENGTHENING IRON-BASE ALLOYS BY SHOCK WAVES
B. G. Koepke, R. P. Jewett, and W. T. Chandler Wright-Patterson AFB, Ohio, AF Materials Lab., Oct. 1964 149 p refs
(Contract AF 33(657)-11250)
(ML-TDR-64-282; AD-607789)

A study was conducted to obtain information on the mechanisms of strengthening produced in iron-base alloys by high-pressure shock waves. Three types of alloys were studied: (1) steels normally hardened by cold work; (2) steels normally hardened by heat treatment; and (3) austenitic steels. Principal investigative techniques employed were transmission electron microscopy and hardness measurements. These alloys were subjected to explosive shock loading at 158 and 283 kilobars. Author

N65-12175# Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
POROSITY IN TITANIUM WELDS
R. M. Evans 8 Jun. 1964 12 p refs
(Contract AF 33(615)-1121)
(DMIC-Memo-194; AD-607072)

Some factors suspected of causing porosity in titanium welds are the following: (1) Hydrogen—Eliminating sources of hydrogen reduces porosity. (2) Cleanliness of joint area—Two factors shown to increase porosity are fingerprints and handling with dirty rags or lint-bearing gloves. Plasticizers dissolved from rubber gloves by solvents, especially alcohol, have been identified as a cause of porosity. Soapy residue in cloths used for wiping cleaned joint areas also has been identified as a cause of porosity. (3) Contamination in filler wire—Surface inclusions worked into the filler wire during drawing have been identified as a major cause of porosity. (4) Welding Procedures and Techniques—Improper technique in tack welding and wide joint gaps in fusion welding have been identified as causes of porosity. Other parameters that play a part in causing porosity are rates of heat input, rates of cooling, welding speeds, arc voltages, and rates of gas flow. Author

N65-12196# Northrop Corp., Hawthorne, Calif. Norair Div.
TANTALUM AND MOLYBDENUM BRAZING TECHNIQUES Technical Documentary Report, 1 Jun. 1963–30 Jun. 1964
A. H. Freedman, L. H. Stone, and E. B. Mikus Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 151 p refs
(Contract AF 33(657)-11227)
(ML-TDR-64-270; AD-606576)

Development is discussed of molybdenum and tantalum braze systems that braze at relatively low temperatures, but develop high remelt and service temperatures. The most promising method of developing high remelt temperatures involved the diffusion-sink brazing approach. A Ti-25Cr-13Ni diffusion-sink braze alloy that melted at 2200° F produced the highest remelt temperatures on TZM (>3100° F). Pure titanium, Ti-30V and 33Zr-34Ti-33V diffusion-sink braze alloys produced the highest remelt temperatures on Ta-10W (>3600° F). Pure titanium, Ti-30V, and 33Zr-34Ti-33V diffusion-sink braze alloys (along with the alloy Cb-1.3B) were evaluated on the Ta-8W-2Hf and Ta-30Cb-7.5V alloys. The tee and lap joint strengths were equivalent to those achieved on Ta-10W. Development of high remelt temperatures by using the diffusion-sink brazing approach was demonstrated on TZM and tantalum alloys. P.V.E.

N65-12228# Experimental Inst. of Light Metals, Milan (Italy)
TEST METHODS FOR THE STUDY OF STRESS-CORROSION OF ALUMINUM-MAGNESIUM ALLOYS. COMPARISON BETWEEN THE ANODIC METHOD AND OTHER METHODS
Final Report, 1 Jan.–31 Jul. 1964
A. Prati 9 Jul. 1964 35 p *Its* Rept.-13.673/6407.023
(Contract DA-91-591-EUC-2833)
(AD-448217)

In order to confirm the validity of the stress-corrosion susceptibility index as determined by the anodic test method, a series of exposure tests was carried out in a marine atmosphere on aluminum–magnesium alloys for which the index value has been determined. The anodic method consists of a stress-corrosion test in a neutral saline solution accelerated by means of the application of an anodic current. The results showed effective agreement between the index values and the behavior of the materials. In particular, it has been possible to establish that a material that presents an index of 0.3 in the anodic test after the sensitizing treatment at 150° C for 16 hours, is practically free from stress corrosion, and this value can thus be taken as a limit. D.S.G.

N65-12243# British Columbia U., Vancouver (Canada)
STATUS OF RESEARCH PROJECTS [METALLURGY] Summary Report, Jan. 1–Jun. 30, 1964
Jun. 1964 18 p

Abstracts are presented of projects completed, including the growth and deformation of copper whiskers, the plastic deformation of lithium fluoride, the structure and properties of copper-infiltrated iron, the infiltration of porous-metal structures by liquid metals, the deformation behavior of fiber-reinforced copper, the corrosion behavior of nickel and monel in aqueous fluoride solutions, and sintering and grain growth of nonstoichiometric rutile. The status is reported for each of 16 continuing projects and for 4 new projects. The status is given of each of nine contract research projects. D.E.W.

N65-12274*# National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF SOME MAGNETIC PROPERTIES OF Fe-Al ALLOYS [ISSLEDOVANIYE NEKOTORYKH MAGNITNYKH SVOYSTV SPLAVOV Fe-Al]
V. V. Zubov Nov. 1964 7 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 4, Jul.–Aug. 1964 p 3–5
(NASA-TT-F-9211) OTS Prices: HC $1.00/MF $0.50

This work presents the results of a comprehensive investigation of the magnetic quantities I_s, H_c, χ_0, and λ_s in quenched and annealed alloys containing from 7.1 to 32.2 at.% of Al. The analysis of the results based on theory is presented. In addition, a qualitative evaluation is made of the internal stresses and the parameter p which is contained in the Kondorskiy–Kersten relationship for H_c. Author

N65-12287 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.) Metallurgy Div.
THE CONTRIBUTION OF HELIUM BUBBLES TO THE EXPANSION OF NEUTRON-IRRADIATED BeO
H. J. Woollaston and R. S. Wilks 1964 11 p refs
(AERE-R-4560)

Helium bubbles have been seen by electron and optical microscopy in BeO irradiated to about 4×10^{20} nvt ≥ 1 MeV at 1000° C, and the effect on them of postirradiation annealing has been studied. The volume expansion caused by these bubbles has been determined and is smaller than the observed macroscopic expansion. It is concluded that both the helium bubbles and the dislocation loops that are also present make a significant contribution to the expansion. Author

N65-12303*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
THE SUSCEPTIBILITY OF SIX STAINLESS STEELS TO STRESS CORROSION AT AMBIENT AND ELEVATED TEMPERATURES
David N. Braski Washington, NASA, Dec. 1964 21 p refs
(NASA-TN-D-2499) OTS Prices: HC $0.50/MF $0.50

The susceptibility of six stainless steels to stress corrosion has been determined by exposing self-stressed specimens indoors and outdoors at ambient temperatures and also at 550° F. The salt-coated stainless steels were resistant to stress-corrosion cracking at 550° F for exposures from 4000 to 10000 hours. Specimens of AM-350 DA and AM-367 stainless steel were found to be very susceptible to stress-corrosion cracking with exposures less than 5000 hours in both the indoor (with a salt coating) and outdoor (with and without a salt coating) environments, whereas the AM-350 CRT, AISI 301, PH 15-7 Mo, and PH 14-8 Mo displayed excellent resistance. In general, the stainless steels with higher austenite contents appeared to have better resistance to the corrosive effects of salt, both at room temperature and at 550° F. Author

N65-12319*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
MARKED INFLUENCE OF CRYSTAL STRUCTURE ON THE FRICTION AND WEAR CHARACTERISTICS OF COBALT AND COBALT BASE ALLOYS IN VACUUM TO 10^{-9} MILLIMETER OF MERCURY. II: COBALT ALLOYS
Donald H. Buckley and Robert L. Johnson Washington, NASA, Dec. 1964 11 p refs
(NASA-TN-D-2524) OTS Prices: HC $1.00/MF $0.50

The friction and wear characteristics of binary tungsten-cobalt and molybdenum–cobalt alloy systems in vacuum (10^{-9} mm Hg) were determined. The influence of the alloying agents on the crystal transformation of cobalt and the friction and wear characteristics of cobalt were determined at varying sliding velocities to 2000 fpm. Both rider specimens (3/16-in.-radius hemisphere) and disks (2 1/2-in. diameter) were of the same material. The addition of the alloying elements tungsten and molybdenum influenced the crystal transformation in cobalt. The friction and wear characteristics of hexagonal cobalt were obtained to higher sliding velocities (and therefore higher interface temperatures) with the addition of 32.6% tungsten or 25% molybdenum; both alloys delayed the transformation of cobalt from the hexagonal to the face-centered-cubic form. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-11079# Pittsburgh Plate Glass Co., Pa. Glass Research Center
CORRELATION OF THE DSR WITH THE STRENGTH OF GLASS OF DIFFERENT COMPOSITIONS AND CONFIGURATIONS Final Technical Report, 1 Jul. 1963–30 Jun. 1964

R. W. Ansewin Wright-Patterson AFB, Ohio, AF Mater. Lab., 7 Aug. 1964 86 p refs
(Contract AF 33(657)-11219)
(ML-TDR-64-180; AD-608125)

The differential surface refractometer (DSR) is an instrument recently developed to detect and estimate the stress in the surface layers of glass by nondestructive means. This work shows a correlation between the instrument readings and the experimental break strength data for glass of different compositions and configurations. In addition, the utility and some of the limitations of the instrument are discussed. Author

N65-11136# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CHANGES IN MECHANICAL PROPERTIES OF ORGANIC INSULATING MATERIAL DUE TO IONIZING RADIATION
Vladimir Adamec 9 Sep. 1964 17 p refs Transl. into ENGLISH from Elektrotech. Obz. (Prague), v. 52, no. 8, 1963, p 406-411
(FTD-TT-64-506/1+2; AD-448218)

The resistance against irradiation of various electroinsulation materials was evaluated by the changes in the transient or permanent electrical and mechanical properties. Some materials showed good insulation resistance at a maximum dose of 10 mrds; in the case of polymethylmethacrylate and hardened paper, a deformability resistance of up to 100 mrds was observed. The development of the properties of a group of allied materials, in relation to the radiation dosage, was approximated by a convenient model function. G.G.

N65-11193# Naval Civil Engineering Lab., Port Hueneme, Calif.
COATING MATERIAL FOR PREVENTION OF ICE AND SNOW ACCUMULATIONS—A LITERATURE SURVEY
Howard A. Porte and Thomas E. Nappier 12 Nov. 1963 8 p refs
(TN-541; Y-R007-08-410; AD-423715)

The known principles and materials that have applications in preventing the formation of ice and snow on outside surfaces have been reviewed. Field experience has shown that there are no coatings presently available that are effective over extended periods of time. On the basis of the ice adhesion strength of the various coatings, it appears that it would be very difficult, if not impossible, to obtain a material with the necessary physical properties to eliminate the accumulation of ice. Author

N65-11200*# General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
DEVELOPMENT OF LOW TEMPERATURE DIELECTRIC COATINGS FOR ELECTRICAL CONDUCTORS Sixth Quarterly Report
K. N. Mathes 15 Jan. 1963 19 p
(Contract NAS8-2442)
(NASA-CR-59496) OTS Prices: HC $1.00/MF $0.50

Preliminary test results in a study of the crushing of wire-insulation materials at cryogenic temperatures are reported. The advantageous properties of ML insulation noted in previous tests were found to extend to excellent performance under crushing stress. The effects of thermal aging on the flexibility of various nonmetallic wire-insulation materials, measured after immersion in liquid helium are summarized. After 60 days in air at 250° C, Teflon, ML, and the asbestos coatings exhibited remarkably good resistance to thermal aging; the minor impairments noted are discussed. Both PVC (plasticized polyvinyl chloride) and Formex (polyvinylformal) exhibited serious degradation. The electrical loss at liquid-helium temperatures for all materials tested was found to be so low that no practical problems should be encountered. Mandrel flexibility tests for ribbon cable insulated with various materials are continuing. M.P.G.

N65-11359# Army Natick Labs., Mass. Clothing and Organic Materials Div.
STUDY OF THE PHENOMENON OF COLD-DRAWING (PLASTIC YIELD) IN HIGH POLYMERS
R. D. Andrews, Jr. and W. Whitney Aug. 1964 70 p refs
(Contract DA-19-129-AMC-100(N))
(C&OM-3; AD-447223)

An exploratory study of the phenomena of cold-drawing and plastic yield in high polymers is described in which the stress–strain properties and the geometry of yielding were investigated for two glassy amorphous polymers; polystyrene and polymethyl methacrylate. Stress–strain properties and cold-drawing behavior of polystyrene (PS) were obtained in tensile tests at constant strain rate as a function of temperature and degree of preorientation. The drawing of polystyrene in dead-load tensile creep was also investigated. The properties of polymethyl methacrylate (PMMA) were investigated in tensile tests at constant strain rate as a function of temperature, strain rate, molecular weight, and cross-linking. Compression tests were run on both polymers to study the effect of a different stress field; effects of temperature and of density changes produced by thermal history were also examined. Throughout these experiments, the exact deformation and/or fracture mode was noted. General conclusions and recommendations for future studies in this area are presented. Author

N65-11463# Kaysam Corp. of America, Paterson, N.J.
STUDY OF PHYSICAL AND CHEMICAL CHARACTERISTICS OF BALLOONS AND BALLOON MATERIALS Second Quarterly Progress Report, 1 Jun.–31 Aug. 1963
Eric Nelson [1963] 57 p
(Contract DA-36-039-AMC-02160(E))
(Rept.-2; AD-424623)

The use of poly-isoprene in conjunction with Neoprene 673, in order to prevent crystallization of the latex, was completely investigated. The behavior of neoprene latex during long storage in unagitated tanks was investigated. Physical properties of films made from samples drawn from the top and bottom of the tank at 30-day intervals showed no variation. The ASP-100 clay was evaluated as a reinforcing filler. An investigation of the effect of increasing the amount of accelerator above normally accepted levels was conducted. The value of Antox as a replacement for both Neozone "D" and NBC was investigated. Physical characteristics of various sections of balloons made from filtered and unfiltered compounds were determined. A series of flights was conducted with balloons having varying cure times and temperatures, in order to confirm that the optimum cure, as determined by laboratory tests, produced balloons with the best flight performance. Balloons made from a compound containing ASP-100 clay were flown, and their performance was found to be similar to that of balloons made from compounds without such a reinforcing filler. P.V.E.

N65-11506# Union Carbide Plastics Co., Bound Brook, N.J.
RESEARCH ON IMPROVED EPOXY RESINS Quarterly Progress Report, 1 May–1 Aug. 1964
J. R. Harvey, W. P. Mulvaney, R. F. Sellers, and S. G. Smith, Jr. 1 Aug. 1964 28 p
(Contract Nonr-4172 (00) (X))
(AD-603748)

The purpose of this program is to define the correlation of novel polyepoxide molecular configurations with the physical

properties of cast resins as the initial step in providing significant improvements in filament-reinforced plastics for deep submergence structures. A discussion of the relationship of physical properties to molecular configuration and to the relative purity of representative sample resins is presented. A major breakthrough in compressive properties was found in EP-2114, which showed modulus greater than 1 000 000 psi and yield greater than 50 000 psi. Author

N65-11523# Forest Products Lab., Madison, Wis.
EFFECT OF PRE-CYCLIC STRESSES ON FATIGUE LIFE OF PLASTIC LAMINATES REINFORCED WITH UNWOVEN FIBERS
Kenneth H. Boller Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 32 p
(Contract AF 33(657)-63358)
(ML-TDR-64-168; AD-606769)

The fatigue life of five types of plastic laminates, made of Scotchply epoxy resin and unwoven E-glass fibers, was measured at two stress levels after damage had been programed at either higher or lower stress levels. The laminates were made of three types of resin and two orientations of fibers: ± 5°, and at 0° and 90° to the principal axis. The S-N curves are presented for these laminates from 1/4 cycle to 10 million cycles. Five replications of tests are presented to establish median fatigue lives at specific stress levels. The three specific stress levels were at approximately 40%, 60%, and 80% of their ultimate strength. In general, the results show that if these laminates are subjected to one or three cycles at the 80% level and then cycled to failure at the 40% or 60% level, the first cyclic stress does not significantly affect the fatigue life at the second stress level. Author

N65-11562# Westinghouse Electric Corp., Pittsburgh, Pa. Research Center
LAMINATES FOR HIGH TEMPERATURE Monthly Letter Report, Apr. 1963
J. H. Freeman 30 Apr. 1963 5 p
(Contract AF 33(657)-9078)
(MLR-8; AD-606330)

Means by which equal performance can be achieved from laminates made under conditions of lower than normally used temperature and pressure are being studied. A polymer series was prepared in which pentaerythritol was used to create polyester cross-links. Laminates have been made, and the initial aging data are given. Attempts to determine the effect of plasticization (caused by a lower molecular weight polymer) on the laminating conditions are discussed. Resins prepared from BTDA were investigated to confirm the fact that the viscosity declines over a period of time, and that the final viscosity and the rate of decline are extremely dependent on the absolute amount of dianhydride added to the polymer. Experiments were also performed to observe the effect of varying the concentration of solution during the preparation of the polymer (MPD-BTDA). P.V.E.

N65-11576# Rock Island Arsenal Lab., Ill.
PLASTIC FILMS: THEIR USEFULNESS IN THE FABRICATION OF TRANSPARENT BARRIER MATERIALS
L. W. Lynch 25 May 1964 20 p refs
(RIA-64-1763; AD-605216)

Data are presented on the properties of ten recently received plastic films along with data on thirty-five films reported earlier. Fifteen films, selected from this group as representative of plastic film types, were tested for fungus resistance, corrosiveness to metals, and stability to storage at elevated temperatures. Polyvinylidene chloride, rubber hydrochloride, and polyvinyl chloride were found to be corrosive; cellophane and polyvinyl chloride are not fungus resistant; cellophane, polyvinylidene chloride, and rubber hydrochloride have poor stability to storage; polyethylene and polyvinyl chloride are rated as having only fair storage stability. Author

N65-11582# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE COMPOSITION AND PROPERTIES OF A TURBINE DISTILLATE OF TUYMAZY OIL
N. G. Kalantar, V. I. Glazunov, and V. S. Mannafova 17 Mar. 1964 14 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 9, 1963 p 31–38
(FTD-MT-63-241; AD-605902)

An analysis and study of the properties of a turbine distillate of Tuymazy oil are described. Results are discussed of subjecting to chromatographic separation on silica gel raffinate and an extract obtained from the same distillate during extraction of 170% aqueous phenol. P.V.E.

N65-11684# Brown U., Providence, R.I. Applied Mathematics Div.
A STRESS WAVE STUDY OF THE DILATATIONAL RESPONSE OF SOME VISCOELASTIC SOLIDS
J. M. Lifshitz Aug. 1964 49 p refs
(Contract Nonr-562(30))
(TR-8; AD-605205)

Measurements were made of the change of shape of spherically diverging stress pulses in three viscoelastic solids—polyethylene, polymethylmethacrylate, and polystyrene. The stress pulses were produced by the detonation of small explosive charges on blocks of these materials, and the pulses were detected by the use of condenser microphones. The stress amplitudes were sufficiently small for the theory of linear viscoelasticity to apply, and the attenuation and dispersion of the pulses enabled values to be obtained for the real and imaginary parts of the bulk modulus. For both polyethylene and polymethylmethacrylate the "bulk loss" was about one fifth of the mechanical loss in shear. For polystyrene the bulk losses were so small that the assumption of elastic behavior was as close as any other assumption; in this material the shear losses are also very small. Author

N65-11705# Stanford U., Calif. Div. of Engineering Mechanics
SOME RECENT DEVELOPMENTS IN LINEAR VISCOELASTIC STRESS ANALYSIS
E. H. Lee Jun. 1964 13 p refs Presented at the 11th Intern. Congr. of Appl. Mech., Munich, Sep. 1964
(Contract Nonr-225(69))
(TR-150; AD-603557)

Recent work in linear viscoelastic stress analysis has emphasized formulation of the theory and methods of solution for general linear material behavior. The structure of the theory is considered, as well as approaches to various types of boundary value problems (i.e., moving boundaries and mixed-type boundary conditions), which prevent the direct use of transform methods. A discussion is included of the influence of temperature variation on the basis of thermorheologically simple material response. Author

N65-11763# California Inst. of Tech., Pasadena W. M. Keck Lab. of Engineering Materials
PHYSICOMECHANICAL BEHAVIOR OF RUBBERLIKE MATERIALS Polymer Science Report
P. J. Blatz and W. L. Ko May 1964 27 p refs
(Contract AF 04(611)-9572)
(MATSCIT-PS-64-3; AD-608230)

Ring samples, die cut from sheets of SBR, were stretched at various extension ratios from 2.47 to 3.12, to provide simple tensile data at room temperature. The relations between break stress, extension ratio, and break time were analyzed. A batch of silicone rubber, containing approximately 30 wt percent of graphite was examined for conductivity; the effect of variations in electrodes and bonding methods was noted. As a preliminary to detailed studies of the kinetic preparation of lattices of varying dispersions, the widely accepted mechanism for the free-radical-initiated polymerization of a monomer in a nonchain-transferring solvent was discussed and amended. Several new ideas for simplification of the kinetic treatment are suggested. R.L.K.

N65-11770# Aerojet-General Corp., Azusa, Calif. Structural Materials Div.
NON-EVACUATED CRYOGENIC THERMAL INSULATION STUDIES Summary Technical Report, 15 Jul. 1963–30 Jun. 1964
C. L. Johnson and D. J. Hollweger Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 89 p refs *Its* Rept.-2887
(Contract AF 33(657)-11200)
(ML-TDR-64-260; AD-607891)

A survey was made of the technical literature dealing with the behavior of porous insulating media suitable for cryogenic service. This survey was accomplished with special emphasis placed on heat-transfer characteristics in the transitional pressure range where the Knudsen number is approximately equal to 1.0. The thermal accommodation coefficient was studied for its application to very fine powders, and its probable effect on heat transfer through powders was evaluated. On the basis of the literature survey, a heat-transfer model was devised that depicts heat as being transported by three heat-transfer modes operating independently and in parallel. Experimental data were gathered on the thermal conductivity of a mixture of carbon black and silica powder having an average particle diameter of 85 Å. Data were collected for several powder mean temperatures and densities, with helium, neon, and nitrogen used as interstitial gases at atmospheric pressure. The heat-transfer model was compared to the experimental data, with good correlation. Author

N65-11775# California Inst. of Tech., Pasadena W. M. Keck Lab. of Engineering Materials
PHYSICOMECHANICAL BEHAVIOR OF RUBBERLIKE MATERIALS
P. J. Blatz, N. George, W. L. Ko, A. Murthy, and J. Yoh Sep. 1964 48 p refs
(Contract AF 04(611)-9572)
(MATSCIT-PS-64-8; AD-608229)

For the controlled evaluation of several gum-rubber vulcanizates in simple tension as a function of time, temperature, and strain rate, the geometry of the ring specimens are discussed, and the stress and strain variables to be obtained from the Instron record are defined. Other studies of the mechanical behavior of gum-rubber vulcanizates include estimation of the network entropy of polymer chains using nongaussian statistics, the derivation of a new distribution function for relaxation times to provide for rapid interconversion of creep, relaxation, strain rate, and dynamic loading data, and the comparison of experimental and predicted uniaxial constant strain-rate tensions. In the study of the electrical behavior of gum-rubber vulcanizates, a bridge method for the measurement of inductance introduced by the twisting of a silicone rubber rod is presented and analyzed. The kinetics of free-radical polymerization are also discussed. D.S.G.

N65-11912# Wyandotte Chemicals Corp., Mich.
SYNTHESIS OF LOW TEMPERATURE OIL RESISTANT URETHANE ELASTOMERS Quarterly Progress Report, 15 May–31 Aug. 1964
S. L. Axelrood and W. J. Lajiness 31 Aug. 1964 35 p
(Contract DA-20-018-ORD-24883)
(QPR-6; AD-607284)

Cast urethane–urea elastomers were prepared from blends of high-molecular-weight polyethers and polytetramethylene ether glycols that meet the mechanical strength, compression set at 100° C, and low-temperature flexibility at –55° C requirements of the contract. Work continued on evaluation of various diisocyanates, diamines, and low-molecular-weight chain extenders in the elastomer formulations. Also, a 4700-molecular-weight polyether diol was evaluated. Author

N65-12047# Naval Research Lab., Washington, D.C. Chemistry Div.
PERFORMANCE CHARACTERISTICS OF THE FPP-15 FILTER MATERIAL USED IN THE USSR FOR ENVIRONMENTAL RADIOACTIVITY MONITORING Final Report
R. L. Patterson, Jr., L. B. Lockhart, Jr., and W. L. Anderson 30 Sep. 1964 10 p refs
(NRL-6165; AD-608209)

A survey of the physical properties and operational characteristics has been made of the FPP-15 filter paper widely used in the Soviet Union for monitoring airborne radioactivity. This filter material is composed of a thin mat of small-diameter, unoriented fibers of polyvinyl chloride deposited on a cotton scrim backing. Due to its composition, the filter readily picks up an electrostatic charge, which causes some difficulty in handling, but which contributes to an increased initial retentivity toward submicron aerosol particles. Functionally, the filter combines low resistance to airflow with good retentivity toward fission-product aerosols. Author

N65-12166# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
TECHNOLOGY OF NEW DEVITRIFIED CERAMICS—A LITERATURE REVIEW
Barry R. Emrich Sep. 1964 160 p refs
(ML-TDR-64-203; AD-608217)

A comprehensive review of the worldwide open literature was made to assist the research and development engineer in future work, and inform the applications engineer of the present uses and capabilities of devitrified ceramics. The devitrified ceramics of primary concern are those materials that are predominantly crystalline bodies produced by induced and controlled nucleation, and crystallization of preformed glass articles. This study presents information on compositional and processing factors; fundamental phenomena; properties; the effects of crystal size, heat treatment, and composition on properties; and applications. It also includes selected abstracts. Author

N65-12167# Melpar, Inc., Falls Church, Va.
A SURVEY OF HIGH TEMPERATURE CERAMIC MATERIALS FOR RADOMES Technical Documentary Report, 1 May 1963–1 May 1964
L. K. Eliason and G. C. Zellner Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 329 p refs
(Contract AF 33(667)-10519)
(ML-TDR-64-296; AD-607619)

A comprehensive survey was conducted of available information concerning the use of nonmetallic inorganic refractory material in the fabrication of radomes for elevated temperature use. In conducting this survey, both open literature

and contract reports were studied. The available data were analyzed to determine their validity, and the information considered to be reliable and accurate was compiled in both tabular and graphical form. Throughout this effort, it was difficult to characterize completely the majority of the materials in terms of chemical composition. Author

N65-12192# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center
A SURVEY MATERIALS REPORT ON TETRAFLUOROETHYLENE (TFE) PLASTICS
John T. Milek Sep. 1964 105 p refs
(EPIC-S-3; AD-607798)

A survey of the following properties of tetrafluoroethylene plastics was made: mechanical, electrical, thermal, chemical, and irradiation behavior. Each property set of data represents the greatest range of parameters: temperature, frequency, pressure, voltage, and environmental conditions (vacuum, radiation, etc.) found in the literature. The effects of fillers on every property are also detailed where such data were available. Applications such as space, mechanical, electrical, and cryogenic are treated in some detail for the various fabricated forms of tetrafluoroethylene. A brief discussion of forming and fabrication, joining and fastening methods, and sources of specifications is included. Author

N65-12231# National Weather Satellite Center, Washington, D.C. Meteorological Satellite Lab.
SPECULAR SPECTRAL REFLECTANCE OF PAINTS FROM 0.4 TO 40.0 MICRONS
W. Y. Ramsey Apr. 1964 35 p refs
(MSL-31)

To determine accurately the specular spectral reflectance characteristics of blackened surfaces used in radiometric devices, 40 paints used for blackening were measured. The spectral reflectance measurements were made by two spectrophotometers—a Cary recording spectrophotometer (Model 14) used in the wavelength range from 0.4 to 2.5 microns, and a Beckman infrared recording spectrophotometer (Model IR-7) used in the wavelength range from 2.5 to 40 microns. The actual absolute reflectance values reported are qualitative because of the possibile effects of scattering, which were not determined. R.L.K.

N65-12289# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile & Space Systems Div.
EVALUATION OF ADHESIVES FOR POTENTIAL CRYOGENIC USAGE ON THE S-IVB
L. M. Roseland 26 Apr. 1963 36 p
(SM-43086)

Discussed is a survey of the mechanical properties of commercial available adhesive films and pastes having possible use in cryogenic areas. Specimens for tensile shear, T-peel, climbing drum peel, tensile, thermal shock, creep, and fatigue tests, as well as for sandwich tensile and sandwich flexural shear were made. Tests were conducted at room temperature, −423° F, and at +250° F. P.V.E.

N65-12314*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PRELIMINARY STUDIES OF LIQUID OXYGEN EXPULSION BLADDERS
V. L. Chinberg and H. Perkins 12 Oct. 1964 27 p refs
(NASA-TM-X-53005) OTS Prices: HC $2.00/MF $0.50

Expulsion bladders for liquid oxygen (LOX) were fabricated from several different materials and evaluated by functional testing. The results indicated that materials considered chemically compatible with liquid oxygen generally are unsuited for fabrication of expulsion bladders because of their mechanical properties at low temperatures. Complex expulsion bladders involving reinforced films and predetermined fold patterns performed slightly better than simple unreinforced films. However, extensive improvement will be necessary before the method of LOX transfer can be utilized in zerogravity propulsion systems. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-10966# Illinois U., Urbana
PRIMES GENERATED BY POLYNOMIALS IN ONE VARIABLE
Peter Bradley Russell 1964 166 p refs
(Contract Nonr-1834(18))
(AD-605620)

Since proofs of the prime number theorem are still rather complicated, upper bounds on problems involving the distribution of primes are derived in an effort to simplify the analysis. The two problems are considered: (1) to obtain an upper bound for $Q_f(N)$; and (2) to obtain a similar result for the same problem when one of the polynomials depends on an integral variable n (Schinzel's problem). M.P.G.

N65-10990# Florida State U., Tallahassee
MULTIVARIATE ANALYSIS. I: GENERAL. THE DEVELOPMENT OF STATISTICAL METHODS FOR QUALITY CONTROL AND SURVEILLANCE TESTING
Ralph A. Bradley Aug. 1964 30 p refs
(Contract Nonr-988(08))
(ONR-TR-13; AD-605556)

The theory of multivariate analysis is presented, and its application is discussed. The multivariate normal distribution provides the stochastic model on which the main theory of multivariate analysis is based. The model has sufficient generality to adequately represent many experimental and observational situations. Sample statistics for measurements on sons, the distribution of the sample means, and general procedures and variances of the multivariate analysis are included. G.G.

N65-11010# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
ESTIMATION OF THE TRANSITION DISTRIBUTIONS OF A MARKOV RENEWAL PROCESS
Erin H. Moore and Ronald Pyke (Wash. U) Sep. 1964 30 p
Its Mathematical Note No. 364
(DI-82-0371)

The present paper is concerned with the estimation of the transition distributions of a Markov renewal process with a finite number of states, which extends and unifies some aspects of the results in the special cases of discrete- and continuous-parameter Markov chains. A natural estimator of the transition distributions is defined and shown to be consistent. Limiting distributions of this estimator are derived. A density for a Markov renewal process is developed to permit the definition of maximum likelihood estimators for a renewal process and for a Markov renewal process. Author

N65-11013# Maryland U., College Park
THE RELATIVE ASYMPTOTIC EFFICIENCY OF OPTIMAL NON-PARAMETRIC TESTS

George Kalish [1964] 27 p refs
(Contract Nonr-595(13))
(AD-447685)

The problem of optimality in comparing the best nonparametric test of a given statistical hypothesis with the best parametric test is considered. A review of the literature is presented on the most thoroughly studied problem of this general form—the efficiency comparison of tests of a hypothesis of the equality of two distributions against the alternative that both distributions have a common underlying form, and that one is shifted from the other by a fixed amount. Most of the results cited involve comparisons of Students t-test, the Wilcoxon test, and the Fischer–Yates test. The most general results were obtained by Hajek, who considered the N-sample problem of testing the equality of distributions against shift alternatives with nuisance scale and location parameters. M.P.G.

N65-11032# California U., Livermore Lawrence Radiation Lab.
NUMERICAL CALCULATION OF STATIC MAGNETIC FIELDS IN AN IRREGULAR TRIANGLE MESH
Alan M. Winslow 4 Aug. 1964 42 p refs
(Contract W-7405-ENG-48)
(UCRL-7784)

A general two-dimensional magnetostatic code has been developed that calculates the vector potential and magnetic induction in any plane arrangement of iron, air, and conductors. It uses a mesh composed of irregular triangles in which the mesh lines can be distorted to conform to irregular interfaces and boundaries, thus eliminating the need for special equations at these places. The speed and accuracy of the calculation appear to be comparable to that obtainable using regular meshes. Author

N65-11034# RAND Corp., Santa Monica, Calif.
A NOTE ON THE COMPUTATIONAL SOLUTION OF A SYSTEM OF DIFFERENTIAL EQUATIONS WITH VARYING TIME-LAGS
Richard Bellman and Bella Kotkin Nov. 1964 10 p refs
(PHS-GM-09608-02)
(RM-3835-NIH; AD-424417)

This paper describes how a technique for the reduction of the solution of differential–difference equations with one time lag to the solution of systems of ordinary differential equations can be extended to the more complex situation involving different time lags. Author

N65-11069# RAND Corp., Santa Monica, Calif.
NUMERICAL SOLUTION OF FUNCTIONAL EQUATIONS BY MEANS OF LAPLACE TRANSFORM. VIII: DETERMINATION OF WEIGHTING FUNCTIONS
Richard Bellman, Robert Kalaba, and Jo Ann Lockett Sep. 1964 9 p refs
(Grant PHS-GM-09608-03)
(RM-4213-NIH; AD-606089)

In a recent article, Beck and Rescigno point out that there are some important biochemical and physiological tracer experiments in which it is necessary to determine the weighting function k(t), given the input function f(t) and the output function u(t) where

$$u(t) = \int_0^t k(t-t_1)f(t_1)dt_1.$$

The procedure given in their paper does not seem well suited to experimental or numerical work, since it depends upon the evaluation of various limits and derivatives of k(t). In this paper, it is indicated how the procedures based on the Laplace transform apply directly to this problem, and the significance of these procedures as far as experimental techniques are concerned. Author

N65-11108# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPROXIMATE METHOD OF CONVERSION OF MODIFIED BESSEL FUNCTION $I_p(X)$
M. M. Levin *In its* Invest. in the Area of Radiotech. Mess. 31 Aug. 1964 p 69–73 (See N65-11101 02-14)

For the solution of problems connected with analysis of diode voltmeters, a method is proposed for the approximation of the conversion of a modified Bessel function with large values of the function and argument. Author

N65-11139# Martin Co., Baltimore, Md.
STUDY OF NONLINEAR MECHANICS Final Report, 1 Apr. 1963–28 Aug. 1964
S. Lefschetz and J. P. La Salle 28 Aug. 1964 27 p refs
(Contract AF 49(638)-1242)
(AFOSR-64-1648; AD-606076)

This is a summary report on various studies pertaining to (1) functional differential equations—equations with a time delay for dynamical systems whose future state depends upon a portion of its past history; (2) the mathematical theories of stability and control—for practical application, as well as for use in more abstract research to achieve a better understanding of the basic theory and concepts; and (3) ordinary differential equations and related topics—for establishing the boundedness and unboundedness in the theory of nonlinear oscillations, the parametrization of the three-dimensional rotation group, the equivalence of differential systems, and in the definition of a type of cobordism for which the Euler number is an invariant. G.G.

N65-11141# Lincoln Lab., Mass. Inst. of Tech., Lexington
MULTIDIMENSIONAL PARAMETER ESTIMATION FOR POINT MASS RE-ENTRY TRAJECTORIES Group Report 1964-49
H. Schneider 27 Aug. 1964 58 p refs
(Contract AF 19(628)-500; ARPA Order 498; Proj. Defender)
(ESD-TDR-64-367; AD-446744)

An iterative procedure for estimating the unknown parameters of a coupled set of nonlinear differential equations, given noisy experimental data for the dependent variables, is presented and discussed. The parameters to be estimated are assumed to consist of the initial conditions and a parameter identified as the ballistic coefficient that appears explicitly in the differential equation set. The measurement errors are assumed to satisfy a joint independent gaussian distribution. The iteration method was applied to a computer trajectory determination of the Wallops Island Trailblazer IIa reentry body, using coarse radar data and maximum-likelihood methods. Results are presented showing the convergence of the iterations and the converged maximum-likelihood trajectory of the Trailblazer IIa reentry body. Author

N65-11160# Wisconsin U., Madison
ON THE BAYESIAN ESTIMATION OF MULTIVARIATE REGRESSION
George C. Tiao and Arnold Zellner Dec. 1963 11 p refs *Its* Paper No. 6315
(Contract Nonr-1202; Grant NSF GS-151)
(TR-23; AD-204260)

Some Bayesian estimation procedures are discussed for the parameters in the following m-equation multivariate regression model: $\gamma_\alpha = X_\alpha\beta_\alpha + u$ and $\alpha = 1,2, \ldots, m$, where γ_α is a Txl vector of observation, X_α a Txk_α matrix

of fixed elements with the rank k_α, β_α a k_αx1 vector of regression coefficients and u_α a Txl vector of random disturbances. The traditional multivariate regression model for this case is considered, and the estimation and testing procedures in the Neyman–Pearson theory are fully discussed. G.G.

N65-11166# RAND Corp., Santa Monica, Calif.
THE APPLICATION OF DYNAMIC PROGRAMMING TO ORBIT TRANSFER PROCESSES
F. T. Smith Aug. 1964 55 p refs Presented at the AGARD/NATO lecture series on Orbit Optimization and Advanced Guidance Instrumentation, Düsseldorf, W. Germany, Oct. 1964
(AD-604885)

Dynamic programing is presented as the mathematical theory of multistage decision processes. The state variables of an orbit-transfer process at any instant of time are presented by the vehicle's position and velocity components, or by related sets of parameters. The space-vehicle guidance system is represented as the integrated subprocesses of measurement, computations, and control. A functional block diagram is developed. G.G.

N65-11186# RAND Corp., Santa Monica, Calif.
CHANDRASEKHAR'S X— AND Y—FUNCTIONS
J. L. Carlstedt and T. W. Mullikin Aug. 1964 44 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4113-PR; AD-605251)

A description is given of the results of the application of singular integral equation theory to Chandrasekhar's X- and Y-functions. Both exact and asymptotic formulas are given for the unique functions, which are analytic functions of their argument. Computations are reduced to the solution of rapidly convergent Fredholm equations and to the calculation of various quadratures. Author

N65-11191# Naval Ordnance Test Station, China Lake, Calif. Test Dept.
BINOMIAL RELIABILITY TABLE (LOWER CONFIDENCE LIMITS FOR THE BINOMIAL DISTRIBUTION)
James R. Cooke, Mark T. Lee, and John P. Vanderbeck Jan. 1964 331 p
(NAVWEPS-8090; NOTS-TP-3140; AD-444344)

A binomial reliability table is presented for use in the reliability estimation of items such as missiles and electronic components when the data have been classified by attributes. The table contains lower one-sided confidence limits. The sample size n ranges from 4 to 500 in unit increments, the number of reliable items r ranges from n/2 to n when n is even and from (n-1)/2 to n when n is odd. Six confidence levels are considered—80%, 90%, 95%, 97.5%, 99%, and 99.5%. The true population reliability p (proportion of reliable items in the population) is given to five decimal places. P.V.E.

N65-11203# General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
THE DISTRIBUTION OF PRODUCTS OF INDEPENDENT RANDOM VARIABLES
M. D. Springer and W. E. Thompson Aug. 1964 95 p refs
(TR64-46; AD-447393)

Fundamental methods, based on the Mellin transform and convolution, are developed for deriving probability density functions of products, quotients, and geometric means of independent random variables. The methods are then utilized to obtain probability density functions of the following: (1) products, quotients, and geometric means of independent random monomial variables, in closed form; (2) products, quotients, and geometric means of independent, random, Cauchy variables, in series form for general n and in closed form for $n \leq 10$; (3) products of $n < 10$ independent, random, gaussian variables, in series form; (4) products of $n = 2,3,6$ independent, random, gaussian variables, in tabular form; (5) quotients of gamma, rectangular, and Cauchy, independent, random variables; and (6) mixed products of $n = 2$, namely, a rectangular–Cauchy, a rectangular–gamma, and a rectangular–gaussian product. Author

N65-11224# Technische Hochschule München (W. Germany). Mathematisches Inst.
EXPERIMENTAL RESULTS ON THE METHOD OF "NEBENCHARAKTERISTIKEN" Scientific Report No. 1
Wolfgang Werner 15 Jun. 1964 13 p refs *Its* Ber. No. 6403
(Grant AF-EOAR-63-77)
(AFOSR-64-1604; AD-605507)

Systems of m hyperbolic partial differential equations with $n \geq 2$ space variables are integrated numerically by a method analogous to the method of characteristics for one space variable; one of the space coordinates, x_ϕ, is selected. Linear combinations of the lines of the system are formed such that all dependent variables are differentiated in the same direction $dx_\phi 1/dt$. This leads to a certain number of characteristic directions, each of which characterizes a hyperplane. These hyperplanes touch the characteristic cone along its characteristics. The totality of lines in the "characteristic" hyperplanes, passing through the vertex of the characteristic cone, are called "Nebencharakteristiken" (quasi-characteristics). Two versions of the method have been tested numerically by comparing the results of the computation with known solutions. Author

N65-11244# Illinois U., Urbana. Electrical Engineering Research Lab.
CONSTRAINT ANALYSIS OF MANY-DIMENSIONAL RELATIONS Technical Report No. 2
W. Ross Ashby May 1964 20 p refs
(Grant AF-AFOSR-7-63)
(AFOSR-64-1387; AD-604042) OTS: $1.00

In an attempt to apply information theory to the interactivities of large systems, a preliminary study was made of the simplifications possible when the datum about the linkage between variables was merely whether the linkage was zero or nonzero. The study thus became a study of how to simplify an n-ary relation. A method is developed for detecting and measuring the degree of essential simplicity. The individual relation is made to generate a sequence of progressively simpler relations; where it comes in the sequence determines and measures its degree of essential simplicity. Author

N65-11298# Boeing Scientific Research Labs., Seattle, Wash.
MOMENT CROSSINGS AS RELATED TO DENSITY CROSSINGS
George Marsaglia, Albert W. Marshall, and Frank Proschan Jul. 1964 5 p refs
(DE-82-0358; AD-603582)

Finucan (1964) has proved that if two symmetric densities with common mean and variance cross four times, then the density that is larger in the tails has the greater fourth moment. Although Finucan's proof has the virtue of being simple and geometrically suggestive, it appears not to be readily amenable to generalization. This note indicates how more general moment comparisons can be obtained using the ideas of total positivity. Although the results presented are immediate consequences

of well-known variation-diminishing properties of totally positive functions, their explicit statement may be of interest and may help in understanding the result proved by Finucan. Author

N65-11363# New York U., N.Y. Courant Inst. of Mathematical Sciences
BOUNDARY VALUES OF POTENTIAL FUNCTIONS PRESCRIBED ALONG INTERIOR PATHS
A. S. Peters Sep. 1964 56 p refs
(Contract Nonr-285(55))
(IMM-NYU-331)

Proofs are presented for the fact that the poisson transform obeys the law $P_a P_b \phi = P_{a+b}\phi$. Exposition and simplification of Pollard's proof and methods for the solution of stated laws are presented. It is shown that if

$$P = \frac{(1-\lambda^2)}{2\pi} \frac{\Phi(\alpha)\, d\alpha}{1 + \lambda^2 - 2\lambda \cos(\alpha - \theta)},$$

then P_λ, $P_{\lambda 2}\phi = P_{\lambda\lambda 2}\phi$ and this result is used to solve Poisson's equation for the circle and to solve a particular biharmonic problem. The integral equation that arises from determining the boundary value of a two-dimensional harmonic function from its behavior along an interior closed path, Poisson's equation, is generalized. Also examined are various inversion formulas derived during the exposition and simplification of Pollard's proof, and a derivation of an iteration procedure for the solution of Poisson's equation is presented. P.V.E.

N65-11367# Naval Air Development Center, Johnsville, Pa. Aeronautical Computer Lab.
A SKETCH OF ANALYSIS OF VARIANCE
Alan Gart 29 Jul. 1964 10 p
(NADC-AC-6410; AD-446816)

Background and introductory statistical material is presented, accompanied by examples of the general application of analysis of variance, as well as a detailed discussion of experimental data from a particular study. Author

N65-11373# General Electric Co., Syracuse, N.Y. Defense Electronics Div.
AN INVESTIGATION OF LINEAR FINITE OPTIMUM AND FREQUENCY CONSTRAINED DIGITAL FILTERS FOR RANDOM AND DETERMINISTIC SIGNALS, REVISION 2
C. Arabadjis 15 Aug. 1963 358 p refs
(R62DSD56(Rev. 2))

Two criteria for deriving digital filters are investigated. The first is the optimum digital filter, which minimizes the output mean squared error. Three types of optimum filters are derived depending on the nature of the input signal. The signal may be purely random, with known autocorrelation function; purely deterministic and representable as a linear combination of (p + 1) known functions multiplied by unknown coefficients; or a combination of the two. In all cases the filter is unbiased so that the average value of the output error is zero. The second method is to find that filter whose transfer function best approximates, in a least-square sense, some desired or given transfer function. This is a frequency-constrained filter. Two types of frequency-constrained filters are derived relating to whether or not the input signal contains a deterministic component. If a deterministic component is present, the filter is further constrained to be unbiased. An equivalence between the optimum and frequency-constrained filter is found for the special case in which the random signal and random noise processes are wide-sense stationary and the sampling rate is constant. Author

N65-11381# Miami U., Oxford, Ohio
A COMPLEX POMPEIU PROBLEM
Richard F. De Mar and Philip J. Davis (Brown U.) [1959] 24 p refs
(Contract Nonr-562(36))
(AD-605667)

A number of theorems that can be used in finding a solution to the complex Pompeiu problem are presented. The complex Pompeiu problem is outlined as follows: Given Ω as the set of all Euclidean transformations T of the complex plane, when does the equation

$$\int\int_B f(T(z))\, dx\, dy = 0, T \in \Omega_1$$

for some set $\Omega_1 \subset \Omega$ imply $f = 0$? P.V.E.

N65-11384# Case Inst. of Tech., Cleveland, Ohio
HIERARCHIES OF GENERAL RECURSIVE FUNCTIONS AND ORDINAL RECURSION Technical Report No. 2
Robert J. Fabian Aug. 1964 82 p refs
(Grant Nonr(G)-00077-64)
(Rept.-204; AD-605291) OTS: $3.00

This work examines several ways of imposing partial orderings on various classes of general recursive functions. The objective of these partial orderings, or hierarchies, is to obtain some indication of the difficulty of computation of the ordered recursive functions. The problem is approached from two points of view: (1) The known partial orderings of the primitive recursive and general recursive functions are considered, using the methods of Grzegorczyk and Kleene, respectively. (2) Using an iteration technique a total ordering is imposed on classes of general recursive functions obtained by closing a fixed set of initial functions under all applications of substitution, of primitive recursion, and of a finite number of general recursive functionals. Author

N65-11395# Aerospace Corp., El Segundo, Calif. Electronics Div.
SUBOPTIMAL LINEAR FILTERING FOR CONTINUOUS DYNAMIC PROCESSES
James S. Meditch 15 Jul. 1964 26 p refs
(Contract AF 04(695)-469)
(TOR-469(5107-35)-2; AD-605451)

A theory of suboptimal linear filtering is developed for continuous dynamic processes. The method consists of partitioning the process state vector into two or more parts and designing separate filters for each part. A suboptimal estimate of the process state vector is then obtained by a suitable combination of the separate filter outputs. The central result of the study is the derivation of a linear, first-order matrix differential equation whose solution yields the covariance matrix of the error in the suboptimal estimate. This result provides a straightforward means of comparing suboptimal with optimal performance. An example for a second-order process is presented to illustrate the technique, and a comparison with optimal performance is given. Author

N65-11439# Johns Hopkins U., Baltimore, Md.
ON EXTENSIONS OF ALGEBRAS, COALGEBRAS AND HOPF ALGEBRAS
V. K. A. M. Gugenheim Sep. 1964 3 p *lts* Rept.-1913-M
(Contract DA-31-124-ARO(D)-171)
(AROD-1913-7; AD-450814)

Discussed is an investigation of the fact that a Hopf algebra C is isomorphic to the tensor product A × B of two Hopf

algebras (the isomorphism preserving the structure of A-module and B-comodule). The extended constructions of isomorphism of A-modules and B-comodules have properties analogous to those in the case of abelian categories (they are abelian groups), and there are connecting sequences of order 2. With every extension $A \xrightarrow{i} C \xrightarrow{j} B$, there can be associated two twisting cochains. The theory and significance of these twisting classes remain quite mysterious. P.V.E.

N65-11471# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CALCULATION OF THE EIGENVALUES OF A POLYNOMIAL MATRIX
V. Ya. Natanzon 22 Apr. 1964 9 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 21, no. 3, 1957 p 445–448
(FTD-MT-63-306; AD-602586)

This is a description of a method for the calculation of the roots of a polynomial, as based on the determination of the poles of an inverse function, and utilizing the calculation theories of Hausholder and Konig. G.G.

N65-11502# California U., Berkeley
ON THE PROBLEM OF NORMAL FORMS FOR A SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS AT A SINGULAR POINT
Richard Venti Aug. 1964 49 p refs
(Contract Nonr-222(88))
(AD-605171) OTS: $2.00

Determined are the conditions under which there exists a C^k for some integer change of variables $y = x - \phi(x)$; $\phi(x) = 0(|x|)$ as $x \to 0$, defined in a neighborhood of $x = 0$, which transforms $dx/dt = Ax + X(x)$; $x = (x_1, \ldots, X_n)$ into $dy/dt = Ay$. It has been previously shown that if $a_1, \ldots, a_n$ [$A = (a_1, \ldots, a_n)$] are close in the sense that they can be contained in an open interval of length $\leq k|a_1|$, then there exists a C^k linearization (T). The main result presented shows that it is not the closeness of $a_1, \ldots, a_n$ that is essential for the existence of a C^k linearization (T), but rather the spacing (even to the extent that $a_1, \ldots, a_n$ may have an arbitrarily large spread). P.V.E.

N65-11511# Washington U., Seattle
CURRENT PROBLEMS IN LINEAR AND CONFIGURAL PREDICTION
Paul Horst Sep. 1964 36 p
(Contract Nonr-477(33); Grant NIH-MH-00743-08)
(AD-606672) OTS: $2.00

Concepts of mathematical functions and predictions are introduced in which the functions are classified as follows: Type A—linear in both parameters and variables; Type B—linear in parameters and nonlinear in variables; Type C—nonlinear in parameters and linear in variables; and Type D—nonlinear in both parameters and variables. Configural prediction can be regarded as a special case of linear prediction of both Type A and Type B functions. A somewhat different application of the multivariate polynomial function—multivariate transformation to a multinormal distribution—and its implications for multiple prediction are considered. Several aspects of these problems that warrant further investigation are suggested. M.P.G.

N65-11561# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
REMARKS ABOUT SOLUTIONS OF CERTAIN NONLINEAR DIFFERENTIAL EQUATIONS
Wang Sheng-wang 26 May 1964 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 150, no. 5, 1963 p 967–970
(FTD-MT-64-24; AD-606755)

Solutions to certain nonlinear differential equations are studied using variational methods. Some remarks relative to convex functionals and solutions of functional equations are included. M.P.G.

N65-11579# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING METHODS OF REFINEMENTS BY DIFFERENCES OF HIGHER ORDERS AND H^2-EXTRAPOLATION
Ye. A. Volkov 5 Mar. 1964 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 150, no. 3, 1963 p 455–458
(FTD-MT-63-221; AD-602568)

A method of refinements by differences of higher orders of the solution of the mixed boundary-value problem for the Poisson equation in the rectangle is reported, and a theorem is presented that gives the basis of the method. The method of refinements, in contrast to the usual grid methods, allows the derivation of an approximate solution with an error whose order of smallness relative to a step of grid h is higher the larger the number of bounded derivatives of the sought solution. The obtained expansion of the error by degrees h also allows application of the refinement method to an approximate solution constructed for different h of the method of h^2-extrapolation and its generalization. M.P.G.

N65-11586# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FORMULAS FOR THE CALCULATION OF THE DETERMINANT OF A SQUARE MATRIX OF ONE PARTICULAR FORM
V. Ya. Natanzon 4 May 1964 7 p ref Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 21, no. 4, 1957 p 593–595
(FTD-MT-63-307; AD-602578)

An equation, $(A-\lambda E)X=0$, is given in which elements of the square matrix $A=(a_{ik})_1^n$ satisfy the condition $a_{ik}=0$ when $i-k>1$. The eigenvalues and vectors of matrix A are to be found. By letting $C=A-\lambda E=(c_{1k})_1^n$, formulas are derived that are convenient for calculating the determinant whose elements consist of the c_{1k} coefficients. Author

N65-11587# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ABOUT PROJECTION PROPERTIES OF THE ORTHOCENTRIC TETRAHEDRON
Z. Riyves 7 Apr. 1964 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk Eston. SSR, Ser. Fiz. Mat. i Tekhn. Nauk (Tallinn), v. 9, no. 1, 1960 p 69–74
(FTD-MT-63-310; AD-606965)

The theorem of Pol'ke–Schwarz ascertains that it is possible to consider any complete quadrangle as a parallel projection of a tetrahedron of arbitrarily selected form. During reconstruction of the quadrangle, it is possible arbitrarily to select five parameters in order to obtain the fully defined form of a tetrahedron. Author

N65-11588# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
POLAR CONJUGACY WITH RESPECT TO SOME FIGURES OF II-ND ORDER IN THE IV-DIMENSIONAL SPACE
V. A. Manevich 16 Apr. 1964 7 p ref Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 10, no. 3, 1958 p 333–334
(FTD-MT-63-313; AD-605899)

A. K. Vlasov defines elementary figures of the second order in a bundle of spaces as axisters and elementary figures of the second order in a set of spaces passing through one point as conosters. Using these definitions, proofs are presented for a series of theorems that pertain to axisters and conosters of a 4-dimensional space, which are formed by a method given by Vlasov. D.E.W.

N65-11589# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ABOUT ONE GEOMETRIC METHOD OF FORMATION OF TECHNICAL FORMS OF SURFACES
I. I. Kotov 4 May 1964 12 p refs Transl. into ENGLISH from Nauchn. Dokl. Vysshei Shkoly, Mashinostr. i Priborostr. (Moscow), no. 3, 1958 p 108–113
(FTD-MT-63-315; AD-602576)

The descriptive geometry of a four-dimensional space is used in methods for the construction of surface forms. The possible case when two nonsmooth competing surfaces determine a smooth surface as derivative is developed by the use of composed equations that are applicable to constructed surfaces. G.G.

N65-11590# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON FORMULAS OF NUMERICAL DIFFERENTIATION WITHOUT DIFFERENCES
D. P. Grossman 28 May 1964 11 p refs Transl. into ENGLISH from Tr. Aviats. Inst. (Moscow), no. 61, 1956 p 30–36
(FTD-MT-63-335; AD-605888)

Discussed are formulas for numerical differentiation without differences, of the form $h^k f^{(k)}(a) = \sum_{i=1}^{n} c_i^{(k)} f(a+t_i h) + R_k^{(n)}$, $(0<k<n)$ in order to find the dependence of the remainder $R_k^{(n)}$ on h, $t_1, t_2, \ldots t_n$, and also to find the expression of the coefficients, $c_i^{(k)}$, in terms of $t_1, t_2, \ldots t_n$. Two theorems are presented with proofs. Both were published earlier without proofs. D.E.W.

N65-11591# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
METHOD OF THE CONTOUR INTEGRAL AND ITS APPLICATION TO THE SOLUTION OF MANY-DIMENSIONAL MIXED PROBLEMS FOR DIFFERENTIAL EQUATIONS OF THE PARABOLIC TYPE
M. L. Rasulov 10 Mar. 1964 32 p refs Transl. into ENGLISH from Mat. SB., Novaya Ser. (Moscow), v. 60 (102), no. 4, 1963 p 393–410
(ETD-MT-64-33; AD-605603)

A new method for the solution of mixed problems for differential equations of the parabolic type is presented. An analysis of the solution in the form of a contour integral through the solution of the corresponding spectral problem is developed, and the homogeneous equation for the boundary condition and the zero initial condition is formed. G.G.

N65-11595# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HELICAL PROJECTION AND ITS APPLICATION IN SOLVING GEOMETRICAL AND TECHNICAL PROBLEMS
A. M. Tevlin 16 Apr. 1964 18 p refs Transl. into ENGLISH from Izv. Vyssh. Uchebn. Zavedenii, Elektromekhan. (Novocherkassk), no. 2, 1962 p 130–141
(FTD-MT-63-301; AD-605869)

Geometric principles are developed for a new method of curvilinear projection of space objects onto a plane in which helixes with a common axis and identical parameter are projections. The construction of helical projections of the main geometric-form application of the method of helical projection in solving different geometrical and technical problems is shown. The method makes it possible to obtain degenerate projections of helical surfaces on the horizontal or frontal plane of projections and to obtain a simple solution of problems with these surfaces. Author

N65-11598# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPLICATION OF METHOD OF CONSECUTIVE APPROXIMATIONS TO PROBLEMS OF STABILITY AND OSCILLATIONS OF ELASTIC SYSTEMS
V. Ye. Popovich [1964] 13 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebv. Zavedenii, Aviats. Tekhn. (Kazan), no. 4, 1962 p 103–110
(FTD-MT-63-291; AD-605865)

An approximate method of reduction for the problem of eigenvalues of differential equations with variable coefficients to an algebraic equation relative to the unknown parameter is presented. This method can be applied without any connections with preliminary approximations on unknown functions; it reduces the problem to an algebraic equation; and it gives a solution with a bilateral estimate of the accuracy of the obtained result. The given method differs from the method of successive approximations further by the fact that in the process of each consecutive approximation it is not necessary to satisfy the boundary conditions. G.G.

N65-11620# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE REPRESENTATION OF THE COLLINEATIONS IN THE PLANE AS THE PRODUCT OF TWO CORRESPONDENCES
V. A. Manevich 7 Apr. 1964 6 p ref Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 10, no. 2, 1958 p 219
(FTD-MT-63-314; AD-606762)

A structural solution is given for the problem of the possibility of presenting any colinear conformity on a plane, except the case when the collineation has only one double point and this point lies on a double line. The described solution indicates the existence of a connection between a network of collineations on a plane and a bundle of curves of the second order. M.P.G.

N65-11621# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE FROMMER DISTINCTION PROBLEMS
R. E. Vinograd and D. M. Grobman 22 Apr. 1964 10 p refs Transl. into ENGLISH from USP. Mat. Nauk (Moscow), v. 12, no. 5, 1957 p 191–196
(FTD-MT-63-319; AD-605915)

An equation $dy/dx = Pn(x,y)' + p(x,y)/Qn(x,y) + q(x,y)$, where Pn and Qn are homogeneous polynomials of degree n, and p and q join terms of higher order, is transformed to polar coordinates. A solution by a single method is offered for both problems of distinction due to Frommer: (1) to establish the uniqueness of the curve specified by the theorem that, if k is odd and $a_0 > 0$, then there exists at least one integral curve entering the coordinate origin with tangent $\phi = 0$; (2) to determine which of the two situations takes place as expressed by the theorem that if k is even, then there exists either an infinite set or not an infinite set of such a curve. The solution is for the general case, and only those minimum assumptions about the smallness of p and q are used that can be considered almost necessary for the first problem. M.P.G.

N65-11622# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON A CRITERION OF INSTABILITY IN THE SENSE OF LYAPUNOV OF SOLUTIONS OF A LINEAR SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS
R. E. Vinograd 7 May 1964 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 84, no. 2, 1952 p 201–204
(FTD-MT-63-326; AD-602589)

The problem concerning the stability of the equation $\dot{y} = A(t)y$ in the particular case $A(t) = \text{const.} = A$ is solved by a study of the eigenvalues and elementary divisors of matrix A. Using a new method, a component of which is the reduction of the given equation to a special form, a criterion of instability is derived, as well as its generalization to certain classes of nonlinear equations. M.P.G.

N65-11623# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON ZEROES OF THE INDIVIDUAL SUMS OF A POWER SERIES
T. I. Krasnoshchekov 4 May 1964 7 p Transl. into ENGLISH from Tr. Aviats. Inst. (Moscow), no. 61, 1956 p 37–40
(FTD-MT-63-333; AD-602580)

A given power series and the sequence of its individual sums are considered. Using properties of normal family, the theorem of Jentzsch (all points of circumference $|z| = 1$ are maximums for zeros of individual sums of series) is proved, as is the following theorem: if $\overline{\lim_{n\to\infty}} |a_n/a_{n+1}| = 1$, then the number of zeros of any function Sn(z) from sequence [Sn(z)] is limited in the region $|z| \leq 1 + \delta$, where δ is as small a positive number as desired. M.P.G.

N65-11630*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MATHEMATICAL MODELS OF MISSILE LAUNCHING, PART I
Alfred C. Dahlgren 21 Aug. 1964 8 p refs
(NASA-CR-59593; JPL-TR-32-655, Pt. 1) OTS Prices: HC $1.00/MF $0.50

By means of a mathematical model of the situation, including assumptions about the nature of the delays encountered, an estimate is presented of the expected number of days required to launch three missiles, each from its own pad, allowing no simultaneous (i.e., same-day) countdowns or launches. Author

N65-11644# Innsbruck U. (Austria)
APPLICATION OF SPINOR METHODS TO RIEMANNIAN MANIFOLDS Quarterly Technical Status Report, Mar. 1–May 31, 1964
F. Cap [1964] 11 p refs
(Contract DA-91-591-EUC-2947)
(AD-606322)

Included are brief discussions of the fundamentals of spinor transformations in Riemannian space and spin and angular momentum in the general theory of relativity. P.V.E.

N65-11645# Innsbruck U. (Austria)
REPORT ON A VISIT OF PROFESSOR E. SCHMUTZER Special Scientific Report No. 6
W. Majerotto and F. Cap [1964] 10 p
(Contract DA-91-591-EUC-2947)
(AD-606325)

A lecture in which professor Schmutzer discusses the present status of spinor theory within the general theory of relativity is reviewed. First, derivations from the formal analogy are made, leading to tensor formulas and spinor formulas, and are followed by axiomatic construction of spinor calculus. The adjoint field function ψ is defined, and the difficult problem of the transformation of spinors is discussed. M.P.G.

N65-11657# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPLIED MATHEMATICS AND MECHANICS Selected Articles
30 Mar. 1964 50 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 27, no. 3, 1963 p 393–417, 428–435
(FTD-MT-63-226; AD-602591)

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1. NONLINEAR TENSOR FUNCTIONS FROM SEVERAL TENSOR ARGUMENTS V. V. Lokhin and L. I. Sedov p 1–34 refs (See N65-11658 02-19)

2. ON ONE METHOD OF SOLVING AN ELASTO-PLASTIC PROBLEM G. P. Cherepanov p 35–46 refs (See N65-11659 02-19)

N65-11658# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NONLINEAR TENSOR FUNCTIONS FROM SEVERAL TENSOR ARGUMENTS
V. V. Lokhin and L. I. Sedov *In its* Appl. Math. and Mech. 30 Mar. 1964 p 1–34 refs (See N65-11657 02-19)

Methods for the automatic calculation of the properties of symmetry in both linear and nonlinear problems are developed through the use of a separation of the corresponding determining parameters that are tied to the main premises in the statements of the investigated problems. Two basic problems are considered: (1) It is shown that the properties of textures and crystals can be given by the use of tensors. Simple systems of tensors are set up that determine and indicate the properties of symmetry for all 7 types of textures and for all 32 classes of crystals. (2) A general form of formulas for tensors of arbitrary rank are established, such that the tensors can be considered a function of a system or arguments consisting of a number of scalars and several independent tensors of different ranks. P.V.E.

N65-11659# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON ONE METHOD OF SOLVING AN ELASTO-PLASTIC PROBLEM
G.P. Cherepanov *In its* Appl. Math. and Mech. 30 Mar. 1964 p 35–46 refs (See N65-11657 02-19)

A method for solving the following problem is presented. Given an unknown closed contour L in the plane of the complex variable $z = x + iy$, second derivative biharmonic functions, which are known functions of coordinates x and y, determine the boundary L and the biharmonic function. The method is applied to the particular case of determining the elastoplastic equilibrium of a plate with a circular aperture, where the aperture contour is an applied constant normal load with tangential components equal to zero, and where at infinity there occurs a state of homogeneous stress. P.V.E.

N65-11777# Wisconsin U., Madison Mathematics Research Center
THE SPECTRA OF INFINITELY OSCILLATING POTENTIALS
J. B. Mc Leod Sep. 1964 31 p refs
(Contract DA-11-022-ORD-2059)
(MRC-507; AD-607823)

This paper discusses the differential equation

$$\frac{d^2y}{dx^2} + [\lambda - q(x)]y = 0 \quad (0 \le x < \infty), \qquad (1)$$

where $q(x) = n(x)g(x)$ and, roughly, $h(x)$ is an increasing function and $g(x)$ is periodic. Apart from various "smoothness" conditions, the two essential conditions on $q(x)$ are that

$$\int_{a_n}^{a_{n+1}} |-q(x)|^{1/2}dx$$

is bounded away from numbers of the form $(k + 1/2)\pi$, for any integer k, a_n, a_{n+1} being successive zeros of $q(x)$ between which $q(x)$ is negative, and that

$$\int_{a_n}^{a_{n+1}} h^{-1/2}(x)\,dx \longrightarrow 0 \text{ as } n \longrightarrow \infty,$$

where a_n, a_{n+1} are now any two successive zeros of $q(x)$. In these circumstances, the problem is limit-point, and the spectrum associated with (1) and a homogeneous boundary condition at $x = 0$ is discrete, with limit-points at $\pm\infty$. Author

N65-11819# Hughes Aircraft Co., Washington, D.C. Technical Analysis Office

HIERARCHIES OF COMPUTABLE GROUPS AND THE WORD PROBLEM

Frank B. Cannonito Griffiss AFB, N.Y., RADC, Sep. 1964 62 p refs

(Contract AF 30(602)-3339)

(TAO-TR-64-1; RADC-TDR-64-274; AD-608036)

The Grzegorczyk hierarchy is extended to include the (partial) recursive functions; sets of integers, with the decision problem restricted to any level of the hierarchy greater than four, are constructed. Necessary and sufficient conditions for a finitely generated group to have its word problem solvable by a function at levels of the hierarchy greater than two are determined. By using the previously constructed sets, examples of finitely generated groups with a decidable word problem restricted to levels greater than four are constructed. The work concludes with a discussion of eight unsolved problems. Author

N65-11909# Wolf Research and Development Corp., West Concord, Mass.

ERROR ANALYSIS: 3-D AZIMUTH (OPTICAL) Scientific Report

Richard M. Moroney Aug. 1963 20 p

(Contract AF 19(628)-2379)

(AD-607971)

The following are discussed: (1) "Errors in Least-Squares Solution of Linear Equations"; (2) "Applications to the Long Line Azimuth Problem"; (3) "Errors in the Long Line Azimuth"; and (4) "Estimation of Data Variance in Least Squares." D.S.G.

N65-11922# California U., Livermore Lawrence Radiation Lab.

TABLES OF CALABRO KAPPA SQUARE STATISTIC

James L. Willows 1 Sep. 1964 64 p refs

(Contract W-7405-ENG-48)

(UCRL-7920, Rev. I) OTS: $3.00

The tables in this report present values of the K^2 (kappa square) statistic developed by S. R. Calabro in which

$$K^2 = [Z_\alpha - Z_\beta\sqrt{k}/k - 1]^2,$$

where Z_α is the normal deviate corresponding to the producer's risk, R_α; Z_β is the normal deviate corresponding to the consumer's risk, R_β; and

$$k = \frac{\text{lot tolerance fractional reliability deviation}}{\text{acceptable reliability level}}$$

This statistic is useful in calculating test time for a given reliability and confidence level. Author

N65-11923# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.

PROCEDURES FOR GENERATING MEANS AND VARIANCES OF STATISTICS WHICH MEASURE "VARIATION" IN DATA EXPRESSED IN THE FORM OF OUTCOMES OF BERNOULLI TRIALS

Sol Haberman Jul. 1964 89 p refs

(Contract NOw-62-0604-c)

(TG-563; PAM-75; AD-448065)

Certain particular statistics are defined that measure "variation" in data expressed in the form of outcomes of Bernoulli trials, and procedures are given for obtaining the moments of such statistics in general. Variation is defined; the enumeration and moments of probability distributions are discussed; four types of statistics are defined and considered; n-dimensional arrays are examined; and several sets of statistics are discussed in detail. D.E.W.

N65-11958# Michigan State U., East Lansing

MAXIMUM LIKELIHOOD ESTIMATES OF MATRICES OF FINITE RANK Scientific Report No. 2

Herman Rubin Bedford, Mass., AFCRL, 28 Oct. 1964 22 p refs

(Contract AF 19(628)-355)

(RM-119; HR-14; AFCRL-64-613; AD-608158)

In estimating an $f \times g$ probability matrix Π, $\pi_{ij} \ge 0$, $\sum_{i=1}^{f}\sum_{j=1}^{g}\pi_{ij} = 1$, is subject to the condition that Π is of rank k. Let n_{ij} be the observed number in cell ij, and let N be the total number of observations. Then $\pi_{ij} = \sum_{r=1}^{k}\alpha_{ir}\beta_{jr}$, and the estimate $p_{ij} = \sum_{r=1}^{k} a_{ir}b_{jr}$ is computed as follows: First $a_{i1} = \sum_j n_{ij}/N$, $b_{j1} = \sum_i n_{ij}/N$. Then values of a_{ik}, b_{jk} for $k > 1$ are guessed such that $\sum_i a_{ik} = 0$, $\sum_j b_{jk} = 0$, and the a's and the b's are corrected alternately. One means of correcting the a's is

$$\Delta a_{ir} = u_{jr} - v_{ir}\sum_{h=1}^{f} u_{hr}/\sum_{h=1}^{f} v_{hr},$$

where $$u_{ir} = (\sum_{j=1}^{g} n_{ij}b_{jr}/p_{ij})/(\sum_{j=1}^{g} n_{ij}b^2_{jr}/p^2_{ij}),$$

and $$v_{ir} = 1/(\sum_{j=1}^{g} n_{ij}b^2_{jr}/p^2_{ij}).$$

Author

N65-12034# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THEORETICAL BASES OF THE METHOD OF POTENTIAL FUNCTIONS IN THE PROBLEM ABOUT INSTRUCTION OF AUTOMATIC MACHINES ABOUT SEPARATION OF ENTRANCE SITUATIONS BY CLASSES

M. A. Ayzerman, E. M. Braverman, and L. I. Rozonoer 22 Oct. 1964 34 p refs Transl. into ENGLISH of "Teoreticheskiye Osnovy Metoda Potentsial'nykh Funktsiy v Zadache ob Obuchenii Avtomatov Razdeleniyu Vkhodnykh Situatsiy na Klassy' Moscow, 1963 p 1-46

(FTD-MT-64-255; AD-607881)

A basic hypothesis is introduced for considering the character of functions, which divide sets, corresponding to different

classes of entrance situations. Proceeding from this hypothesis, theorems of convergence of algorithms for a finite number of steps are proved. These algorithms are realized by a broad class of diagrams. The characteristics of elements, from which are gathered the diagrams of this class, are practically arbitrary. The perceptron of Rosenblatt pertains to this class of diagrams, i.e., it is proved that the work of the perceptron may be comprehended as a realization of the method of potential functions. Author

N65-12037# Wisconsin U., Madison Mathematics Research Center
GALERKIN'S PROCEDURE FOR NONLINEAR PERIODIC SYSTEMS
Minoru Urabe Aug. 1964 82 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-501; AD-607820)

It is shown that Galerkin's procedure is always available for twice continuously differentiable periodic differential systems if a periodic solution is restricted to an isolated periodic solution. This gives an explicit condition for applying Galerkin's procedure and reveals the wide applicability of Galerkin's procedure to general nonlinear periodic differential systems. The proof of this result is based on existence theorems that are derived from an idea contained in Newton's iterative method. The paper also discusses the relationship of Galerkin's procedure to the method of averaging. The paper exemplifies Galerkin's procedure with a certain nonlinear equation. Author

N65-12038# Wisconsin U., Madison Mathematics Research Center
SOME GLOBAL PROPERTIES OF MATRICES OF FUNCTIONS OF ONE VARIABLE
Yasutaka Sibuya Sep. 1964 22 p refs
(Contract DA-11-022-ORD-2059)
(MRC-512; AD-607826)

The global block-diagonalization theorems are proved for an n by n matrix A(x) in the following cases: (1) The elements of A(x) are analytic with respect to a complex variable x in a compact and connected domain D. (2) The elements of A(x) are analytic and periodic with respect to a real variable x. (3) The elements of A(x) have continuous derivatives of all orders with respect to a real variable x, and they are also periodic. Author

N65-12068# RAND Corp., Santa Monica, Calif.
SPECIALIZED MULTIVARIATE BEHRENS-FISHER PROBLEMS
Sheldon James Press Aug. 1964 14 p refs
(NSF GP-214)
(P-2962; AD-604846)

Letting X and Y be independent $p \times m$ and $p \times n$ random matrices whose columns are independently and identically distributed as $N(\mu_1, \Sigma_1)$, $N(\mu_2, \Sigma_2)$, respectively, an attempt is made to test whether or not $\mu_1 = \mu_2$ when $\Sigma_1 \neq \Sigma_2$. The multivariate analogue of the Scheffé procedure is used to develop likelihood ratio tests for Behrens–Fisher problems with specially structured covariance matrices. An optimality property of the multivariate Scheffé transformation-test procedure is demonstrated, and some Behrens–Fisher problems that arise in multivariate regression are considered. P.V.E.

N65-12069# Aerospace Medical Div. Personnel Research Lab. (6570th), Lackland AFB, Tex.
CALCULATION OF THE PERCENTAGE POINTS OF THE F DISTRIBUTION
George I. Neel, Larry K. Whitehead, and Robert A. Bottenberg Jun. 1964 15 p refs
(PRL-TDR-64-16; AD-605820)

This paper reports a procedure for computing the cutoff F statistic (percentage point), given the probability P and the degrees of freedom determined by the experimental design. The technique involves applying a previously developed computing program to compute P from a trial value of F. From the discrepancy between the computed P and the required P a new trial value of F is determined. Iteration continues until the trial value of F produces a computed probability acceptably close to the required probability. The FORTRAN listing of the computing program is given. Author

N65-12102# Polytechnic Inst. of Brooklyn, N.Y.
WIDE-SENSE MARKOFF SEQUENCES AND RECURSIVE FILTERING Memorandum No. 70
A. Papoulis 25 Jun. 1964 7 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1230-64; AFOSR-64-1375; AD-604041)

The orthogonality principle for random variables is stated and proven. This principle is the basis of all linear mean square estimations. A number of basic properties of wide-sense Markoff sequences is given. It is shown that recursive filtering is an immediate consequence of the orthogonality principle. Author

N65-12106# System Development Corp., Santa Monica, Calif.
BAYES DECISION PROCEDURES FOR STIMULUS SAMPLING MODELS. I: NONSEQUENTIAL EXPERIMENTATION
Robert E. Dear 28 Jul. 1964 61 p refs
(TM-1734/000/01; AD-606162) OTS: $3.00

In stimulus sampling models of learning, the probability distribution defined on the sequence of conditioning functions that are used in these models may be regarded as a distribution over parameters. Consequently, this probability distribution is interpreted as an a priori distribution, and the appropriateness of Bayes decision procedures for solving statistical decision problems involving these models is shown. Using beta distributions as a tractable family of prior distributions over the parameters of the single element model, Bayes solutions are illustrated for the learning criterion problem, parameter estimation problems, and the optimal design of a learning experiment. Author

N65-12114# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
ON THE ESTIMATION OF LOCATION COORDINATES FROM DATA TAKEN FROM A MANNED ORBITAL LABORATORY Mathematical Note No. 363
S. C. Saunders and D. L. Johnson Aug. 1964 45 p ref
(DI-82-0370)

A statistical method is presented for finding a good estimate of the path of a moving manned orbital laboratory whose own position coordinates are not known with a high degree of certainty. Two special cases are considered. The first assumes that the distribution of errors is the same at all observations, and the second assumes that the observations are symmetrically located relative to a single target. G.G.

N65-12154# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
WEIGHT DISTRIBUTION OF THE QUADRATIC RESIDUE (71,35) CODE Physical and Mathematical Sciences Research Papers No. 46

Vera Pless Aug. 1964 10 p refs
(AFCRL-64-697; AD-607858)

The hand calculation of the weight distribution of the (71,35) quadratic residue code is briefly described. This calculation falls into two parts. The first part consists of evaluating the 10 X 10 determinant given by the power-moment identities, using properties of Van der Monde determinants. The second part of the calculation consists of reducing the six solutions obtained in the first part to one solution. This reduction is accomplished by group theory analysis. Author

N65-12173# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COURSE ON THE CALCULUS OF VARIATIONS
M. A. Lavrent'yev and L. A. Lyusternik 20 Oct. 1964 294 p Transl. into ENGLISH of the book "Kurs Variatsionnogo Ischisleniya" Moscow, Gos Izd. Tekhn.-Teor. Lit., May 1950 ed. p 1–296
(FTD-TT-64-651/1+2; AD-607307)

Presented is a book on the calculus of variations, containing the following chapters: (1) "Elementary Solution Methods for Extremum Problems"; (2) "Method of Variations"; (3) "Generalizations of the Elementary Problem"; (4) "Admissible Curves with Moving End Points. Discontinuous Problems"; (5) "Conditional Extremum"; (6) "Variational Problems in Parametric Form"; (7) "Field Theory"; (8) "Sufficient Conditions for Strong and Weak Expressions"; (9) "Linear Variational Problems"; and (10) "Minimax Problems." P.V.E.

N65-12174# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
RESEARCH PROGRAM TO EXTEND THE THEORY OF WEIGHT DISTRIBUTION AND RELATED PROBLEMS FOR CYCLIC ERROR-CORRECTING CODES Summary Scientific Report 3
H. F. Mattson and E. F. Assmus, Jr. Jul. 1964 39 p refs
(Contract AF 19(604)-8516)
(AFCRL-64-605; AD-607445)

Cyclic and quadratic-residue codes over finite fields are viewed as arising from such codes over algebraic number fields. That is, if F is any field, the cyclic codes over F block length n are defined as the ideals in $F[x]/(x^n-1)$. When F is an algebraic number field, the module $\sigma[x]/(x^n-1)$ is considered, where σ is the ring of integers of the number field. Those parts of the cyclic codes over F with integral coefficients are submodules. By means of the residue-class map of a prime in F, these submodules are mapped to (finite) cyclic codes over the residue-class field. Author

N65-12199# Argonne National Lab., Ill.
DECOMPOSITION OF THE STATIONARY ISOTROPIC TRANSPORT OPERATOR IN THREE INDEPENDENT SPACE VARIABLES
Erwin H. Bareiss Aug. 1964 41 p refs
(Contract W-31-109-ENG-38)
(ANL-6914) OTS: $2.00

Based on the idea of separation of variables, a decomposition of the three-dimensional linear transport operator is carried out, resulting in continuous sets of regular and generalized eigenfunctions. Because of the nonself-adjoint nature of this operator, the results could not be anticipated intuitively from the known decomposition of this operator in the special case of plane geometry. The results obtained may indicate a new approach to spectral theory. Author

N65-12200# Illinois U., Urbana Coordinated Science Lab.
PSEUDO CUTS AND THEIR APPLICATIONS
Wataru Mayeda Jul. 1964 29 p refs
(Contracts DA-28-043-AMC-00073(E); AF 49(638)-1383)
(R-233; AD-605421)

A nonoriented planar graph G and the dual graph [1,2,3] G' of G are considered. Knowing that a circuit of G is a cut set of G', a set called a "pseudocut" is introduced so that a special pseudocut in G' is a path in G. Similar relationships are developed between the properties of paths in a linear graph and the properties of pseudocuts. Next, the relationship among classes of pseudocuts is discussed, leading to the definition of an important property: the collection of all possible classes of pseudocuts of a nonseparable linear graph is an Abelian group under the cross-ring sum $\otimes$ operation. This property is exactly the same as that of the collection of the classes of paths. Finally, it is shown that a pseudocut is a subset of a set of chords in a linear graph. This property is applied to obtain all possible sets of chords in a nonseparable graph. M.P.G.

N65-12237# Polytechnic Inst. of Brooklyn, N.Y.
UNIFORM OVAL REINFORCING RINGS—POWER SERIES EXPANSIONS
William P. Vafakos and Louis Rostand Aug. 1964 34 p refs
(Contract Nonr 839(14); NSFG-21876)
(PIBAL-697; AD-605218) OTS: $2.00

Power series expansions are employed in the analysis of oval reinforcing rings, which are arbitrarily located on the inside or outside of oval cylindrical shells of prescribed cross section. The expansions are in terms of two small geometric parameters that are fixed by specifying the cross section of the ring and the major and minor axis lengths of the oval. Analytical solutions are presented for the case of a uniform radial load. A graphical comparison is made with the results of a relatively lengthy energy solution. In addition, the effect of inside or outside rings is displayed in graphs, where the results are plotted versus the major-to-minor axis ratio. Author

N65-12238# Johns Hopkins U., Baltimore, Md. Carlyle Barton Lab.
ZERO-CROSSING INTERVALS OF ENVELOPES OF GAUSSIAN PROCESSES
A. J. Rainal Jun. 1964 60 p refs
(Contract AF 33(657)-11029)
(AF-110; AD-601231) OTS: $3.00

This paper generalizes some theoretical results concerning the zero-crossing intervals of both gaussian processes and envelopes of gaussian processes. Some new experimental results concerning the zero-crossing intervals of both types of processes are also presented. It is shown that probabilities and probability densities defined by the zero-crossing points of an envelope process are similar to the corresponding probabilities and probability densities defined by the zero-crossing points of an associated gaussian process. At present none of the probabilities or probability densities can be derived explicitly by analytical methods. The standard deviations of the zero-crossing intervals are also presented. In the case of the associated gaussian process, the correlation coefficient for two successive zero-crossing intervals is presented. Author

N65-12311*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STUDIES IN THE FIELDS OF SPACE FLIGHT AND GUIDANCE THEORY Progress Report No. 6
16 Oct. 1964 383 p refs
(NASA-TM-X-53150) OTS Prices: HC $7.00/MF $2.00

This paper contains progress reports of studies in the areas of space flight and guidance theory. The studies are carried on by several universities and industrial companies. This progress report covers the period from December 18, 1963, to July 23, 1964. Author

N65-12326# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
NEARLY MODULAR ORTHOCOMPLEMENTED LATTICES MATHEMATICAL NOTE NO. 358
M. Donald Mac Laren Jul. 1964 32 p refs
(DI-82-0363)

Let L be a complete, weakly modular, orthocomplemented lattice. A modular element in L is an element a such that [0,a] is a modular lattice and (x,a) is a modular pair for all x. The lattice L is nearly modular if it is semimodular and every element in L is the join of modular elements. The resultant theorems are presented. Author

N65-12327# Battelle Memorial Inst., Geneva (Switzerland)
THEORETICAL STUDY ON HOMOTOPY AND COHOMOLOGY Annual Report, Jun. 1, 1963–May 31, 1964
30 Jun. 1964 95 p refs
(Contract DA-91-591-EUC-2937)
(AR-1; AD-448033)

The following papers dealing with the theory of homotopy and cohomology are presented: (1) "Unions and Intersections in Homotopy Theory"; (2) "Generalized Homotopy Theory"; (3) "Cech Cohomology with Finite Coverings and Homotopy"; and (4) "Categories of Functors and Adjoint Functors". P.V.E.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-11030# Joint Publications Research Service, Washington, D.C.
PRECIPITATION INFLUENCE ON RISING CURRENTS IN CONVECTIVE CLOUDS
N. S. Shishkin 25 Nov. 1964 6 p ref Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 145, 1963 p 20–22
(JPRS-27553; TT-64-51802) OTS: $1.00

This article analyzes the problem of the expenditure of energy on the ascent of precipitation particles in convective clouds. The author has determined at what intensity of precipitation there will be a slowing down of the rising currents. Author

N65-11060# Servicio Nacional de Meteorologia e Hidrologia, Quito (Ecuador)
METEOROLOGY YEARBOOK NO. 3, 1963 [ANUARIO METEOROLOGICO NO. 3, 1963]
1964 152 p In SPANISH

The National Service for Meteorology and Hydrology is described as to organization and as to station types and locations. Daily values are given for a number of meteorologic parameters for the five primary stations; monthly values for the same parameters are tabulated for all stations; and rainfall measurements are listed for each station by months. Daily values of rainfall and monthly values of subsoil temperatures and of minimum temperatures next to the soil are given for several selected stations. Maps are included showing the network of stations, the air temperature and precipitation, and the wind vectors and frequencies by location. D.E.W.

N65-11075# National Weather Satellite Center, Washington, D.C. Meteorological Satellite Lab.
CONFERENCE ON SATELLITE ICE STUDIES
Maurice D. Baliles and Herbert Neiss, ed. Jun. 1963 104 p Conf. held in Washington, D.C., 14 Jun. 1962 *Its* Meteorol. Satellite Lab. Rept.-20

Representatives from the fields of meteorology, oceanography, hydrology, geology, and photogrammetry reviewed the meteorological satellite program, its instrumentation and its ice reconnaisance applications. The joint United States-Canadian project TIREC is described, with specific attention to the efforts made to identify and interpret sea ice features as seen in TIROS IV photographs. The analysis of photographs is discussed. The problem of differentiating between cloud and ice in satellite photographs was countered by ice observers, meteorologists, and photo interpreters working together, by the use of stereo methods, and by the comparison of mosaics of aerial photographs with satellite pictures. Other problem areas covered include radar photography, training interpreters, defining acceptable resolution in photographs, photogrammetric techniques, and dissemination of the information for operational use. R.L.K.

N65-11233# Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF THE RELATIONSHIP BETWEEN THE UNITARY VERTICAL CONDUCTION CURRENT AND WORLDWIDE THUNDERSTORM ACTIVITY
N. A. Paramonov 25 Nov. 1964 13 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 157, 1964 p31–38
(JPRS-27539; TT-64-51788) OTS: $1.00

The degree and nature of the relationship between the vertical atmospheric electric current and the total, worldwide thunderstorm activity is investigated. This relationship is also considered with respect to diurnal, annual, and long-term variation. The rather close relationship found between the lightning current at the earth's surface and the vertical conduction current makes it possible to consider the unitary vertical conduction current as a measure of thunderstorm activity for the entire surface of the earth. D.E.W.

N65-11334# Army Natick Labs., Mass. Earth Sciences Div.
A METHOD FOR ASSESSING THE FREQUENCY AND PROBABLE AMOUNT OF ONE-DAY RAINFALL
Earl E. Lackey Jun. 1964 60 p refs
(TR-ES-9; AD-447403)

If for a certain month, the mean monthly rainfall, the maximum 1-day rainfall within a given period of years, and the length of the record at a given place are all known, then by use of a multiple nomograph one may predict, for the same months in future years, the approximate frequency of 1-day rainfall in excess of given amounts, and the probable maximum rainfall in 1 day for any period from 1 year to 100 years. The maximum 1-day rainfall is used in this study because its value is found in nearly all summary records. The study is based on detailed records of 1-day rainfall for 10-year periods for January, April, July, and October for each of 10 widely distributed component weather stations in North America—in all, 40 monthly records. Author

N65-11609# Army Natick Labs., Mass. Earth Sciences Div.
WORLD MAPS OF HIGH DRY-BULB AND WET-BULB TEMPERATURES
Iven V. Bennett, Richard L. Pratt, and Roland J. Frodigh Aug. 1964 43 p refs
(ES-11, AD-447402)

Methods used in drawing the isolines for each map are presented and their accuracy (where estimated) analyzed. Notes are given to assist in interpreting each map or to explain its limitation in specific areas. As expected, Saharan Africa and southwestern Asia possess a large proportion of the total

world area with high dry-bulb (≥100° F) temperature. Nearly all of the Sahara and large areas in Saudi Arbia, Iraq, West Pakistan, and India commonly experience dry-bulb temperatures between 105 and 110° F. Only small areas in other parts of the world have high frequencies of such temperatures. Truly high wet-bulb temperatures, close to or above 80° F, are widely spread geographically only under humid tropic conditions of climate. They are found along the Pacific coast of southern Mexico, in the Amazon Basin, the Sudan region of Africa, the Mozambique, Tanganyika and Kenya coasts of Africa, southern and southeastern Asia, the islands of the East Indies, and the north coast of Australia. Author

N65-11688# Travelers Research Center, Inc., Hartford, Conn.
SYNOPTIC STUDY OF PREDICTIONS OF CLOUD COVERAGE AND NORMALIZED CLOUD HEIGHT
Marshall A. Atwater 2 Dec. 1963 19 p ref
(Contract Cwb-10704)
(TM-3; AD-605155) OTS: $1.00

Cases in which large errors occurred in the prediction of cloud amount and normalized cloud height have been analyzed. The biggest errors occurred with the westward movement of fronts. Other errors occurred when fronts (moving west to east) passed the predictand point. Local conditions and advection of air over elevated terrain also were reasons for many errors. Parameters that may be helpful in screening runs would upslope motion, and possibly upper air winds to be used for steering and speed of movement of surface features. Possible prediction points should be located east and south of the point for advection in the eastern U.S. Additional frontal parameters may be included to minimize the errors caused by fronts.
Author

N65-11693# Travelers Research Center, Inc., Hartford, Conn.
SCALE ANALYSIS OF TERMINAL WEATHER VARIATIONS Summary Status Report, 1 Jul. 1963–30 Jun. 1964
K. D. Hage 30 Jun. 1964 35 p refs
(Contract Cwb-10704)
(AD-605152) OTS: $2.00

This is a scale analysis of air-terminal weather variations in order to determine the characteristic variability of the weather elements that are of concern in short-period weather forecasting. The variations in atmospheric transmissions were recorded in set intervals by transmissometers installed along the runways of several airports, and were evaluated by computation. G.G.

N65-11761# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTIVE REACTION TO METEOROLOGICAL PROCESSES
Ye. K. Fedorov 13 Oct. 1964 15 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 9, 1962 p 78–85
(FTD-TT-64-667/1; AD-607495)

A discussion of the cause and effect relationship in meteorological phenomena and of research on weather control is given. It is concluded that, if weather predictions can be accurately stated in terms of a hypothetical, but possible, set of conditions and of the actual future weather conditions, effective action may be taken to alter or control the weather on a large scale. D.E.W.

N65-11769# University Coll. of Wales, Aberystwyth (Gt. Brit.)
LARGE SCALE MOVEMENTS OF THE ATMOSPHERE Technical Note No. 1
Pauline Ramm Jul. 1964 209 p refs
(Contract AF 61(052)-690)
(AFCRL-64-852; AD-607898)

A formulation of the full equations of motion for a fluid capable of absorbing and emitting grey thermal radiation is presented. The Rayleigh stability problem is investigated for models with a linear basic temperature profile under certain boundary conditions. In general it is found that in this formulation the presence of radiational absorption tends to stabilize the fluid. The forced motion of a liquid heated from below and subject to a nonlinear basic temperature profile due to internal heat generation is discussed. Author

N65-11978# Johns Hopkins U., Baltimore, Md.
ON THE EQUATIONS OF LARGE-SCALE METEOROLOGICAL PHENOMENA
Robert R. Long Sep. 1964 19 p refs
(Contract Nonr-4010(01); Grant WBG-21)
(ONR-TR-18; WBG-TR-21; AD-605833)

The solutions of the equations of motion governing large-scale atmospheric disturbances are expanded in infinite series involving powers and products of three small parameters, characterizing the mass and velocity fields. The equations of the first approximation are basically nonlinear, but can be combined into a single differential equation in one dependent variable. An example is given of a steadily propagating disturbance satisfying these equations. Author

N65-11992# Travelers Research Center, Inc., Hartford, Conn.
RADAR APPLICATIONS IN TERMINAL AND ENROUTE WEATHER FORECASTING Summary Status Report, 1 Jul. 1963–30 Jun. 1964
J. W. Wilson 30 Jun. 1964 10 p refs
(Contract CWB-10704)
(Rept.-7412-128-C; AD-605154)

Work is reported on the incorporation of a routine into the statistical-properties program for computing the average length and width of weather echoes, on the determination of relationships between statistical properties of the echo patterns and predictability of the patterns, and on the determination of echo movements and predictability of features in the echo patterns as a function of their space scales. D.E.W.

N65-12185# Joint Publications Research Service, Washington, D.C.
HYDROLOGY AND METEOROLOGY IN BULGARIA
2 Dec. 1964 52 p refs Transl. into ENGLISH from Khidrologiya i Meteorol. (Sofia), v. 13, no. 4, 1964
(JPRS-27646; TT-64-51848) OTS: $3.00

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1. THE HYDROMETEOROLOGICAL SERVICE IN BULGARIA DURING THE PAST 20 YEARS St. Stefanov p 1–10
2. SURVEY OF THE DEVELOPMENT OF BULGARIAN CLIMATOLOGY Sv. Stanev p 11–17 refs
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4. THE DEVELOPMENT OF SYNOPTIC METEOROLOGY DURING THE PAST 20 YEARS Stefan Y. Stefanov p 30–41
5. THE STATE AND TASKS OF THE AGROMETEOROLOGICAL SERVICES PROVIDED TO BULGARIAN AGRICULTURE E. Khershkovich and D. Dilkov p 42–49

N65-12222 Naval Postgraduate School, Monterey, Calif.
THE DISTRIBUTION OF TROPOSPHERIC VELOCITY DIVERGENCE WITH RESPECT TO PRESSURE SYSTEMS
Robert F. Alden and Glenn C. Rosenberger (M.S. Thesis) 1964 34 p refs
(AD-603429)

With the aid of an electronic computer, velocity divergence, vertical velocity, and thermal advection computations are performed at the standard pressure levels. These parameters are than related to tropospheric pressure systems, classified according to subsequent development or nondevelopment. Typical plan view and cross section patterns are presented. Author

N65-12235# Joint Publications Research Service, Washington, D.C.
TOWARDS NEW HORIZONS IN METEOROLOGY
N. I. Novozhilov 25 Nov. 1964 5 p Transl. into ENGLISH from Priroda (Moscow), no. 5, May 1964 p 110–111
(JPRS-27546; TT-64-51795) OTS: $1.00

This paper describes the observations of N. M. Przhevalskiy of the diurnal course of temperature, wind, and humidity characteristics for the Gobi Desert near Lop Nor in the years 1871 to 1878. G.G.

N65-12255# Travelers Research Center, Inc., Hartford, Conn.
WEATHER DATA PROCESSING RESEARCH AND DEVELOPMENT PROGRAM Monthly Progress Report
C. F. Jenkins May 1964 18 p
(Contract Cwb-10704)
(AD-601771)

The MDA (multiple discriminant analysis) has been found useful in predicting the probability of operationally critical airfield ceiling and visibility conditions. One part of the discriminant procedure requires at the outset a rather lengthy computation by machine to estimate these probabilities. While the operational use of the method takes much less effort, the time needed initially on a large scale computer may be inordinate when many elements, time periods, and geographical locations are being considered. This technical report discusses a prediction technique, REEP (regression estimation of event probabilities), that resulted from attempts to make MDA more efficient. Comparative studies between REEP and MDA are included as well as other experimentations performed using the REEP procedure. Author

N65-12284# Joint Publications Research Service, Washington, D.C.
ANALYSIS OF TROPICAL CYCLONES AND FORECASTING OF THEIR MOVEMENTS BY USE OF NUMERICAL METHODS
I. G. Sitnikov 11 Dec. 1964 14 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 10, Oct. 1964 p 3–10
(JPRS-27793; TT-64-51914) OTS: $1.00

The reconstruction of a wind field in a tropical cyclone on the basis of the known distribution of the geopotential is considered, and the accuracy of the solution of the vorticity equation at the mean level of the troposphere for perturbations of the tropical cyclone type was determined. It was concluded that the rate of movement of cyclonic centers is predicted somewhat too low, due to the influence of boundary conditions in a limited area. G.G.

N65-12285# Joint Publications Research Service, Washington, D.C.
CHARACTERISTICS OF ATMOSPHERIC TURBULENCE USED IN HYDRODYNAMIC LONG-RANGE WEATHER FORECASTING
A. M. Glazunova 11 Dec. 1964 10 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 10, Oct. 1964 p 33–37
(JPRS-27796; TT-64-51917) OTS: $1.00

The averaged equations of hydromechanics that are used in forecasting smoothed (averaged over a period of time) meteorological elements are discussed. The equations contain not only the smoothed values of meteorological elements, but also values describing the effect of turbulence. In order to clarify the character of the change of the covariance fields as a function of the point relative to which they were constructed, two series of covariance distributions were mapped: (1) for points with fixed latitude and variable longitude and (2) for points with fixed longitude and variable latitude. It is concluded from studying the maps that macroturbulence is nonisotropic and nonhomogeneous. P.V.E.

N65-12286# Joint Publications Research Service, Washington, D.C.
COMPUTING THE TRAJECTORIES OF AIR PARTICLES
I. A. Petrichnko 11 Dec. 1964 11 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 10, Oct. 1964 p 22–27
(JPRS-27797; TT-64-51918) OTS: $1.00

The problem of determining the point from which an air mass should arrive at a particular grid intersection after 24 hours was computed from 120 trajectories for 12 × 10 grid points with an interval of 600 km between each point. For the formation of the Lagrange variables it was assumed that the geopotential field changes linearly with time and that the wind is geostrophic. The machine-determined diagnostic and prognostic trajectories were compared to trajectories determined by manual computations, and the machine method was found to be sufficiently accurate. G.G.

N65-12315*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN EMPIRICAL ANALYSIS OF DAILY PEAK SURFACE WIND AT CAPE KENNEDY, FLORIDA FOR PROJECT APOLLO
J. David Lifsey 27 Aug. 1964 52 p refs
(NASA-TM-X-53116) OTS Prices: HC $3.00/MF $0.50

A fourteen year serially complete data sample of daily peak surface wind was obtained from historical weather records. After adjusting speed values to a reference height of 10 meters above the ground and removing hurricane-associated peak winds, monthly, seasonal, and annual values were computed for the following: selected percentiles and statistics; bivariate empirical percentage frequency distributions of speed versus direction, speed versus hour of occurrence, and hour of occurrence versus direction; and exposure period probabilities (empirical percentage frequencies) of equaling or exceeding peak wind speeds of various magnitudes during consecutive-day time intervals. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-11388# Intermountain Weather, Inc., Salt Lake City, Utah
VISUAL RANGE AS A FUNCTION OF FOG DROPLET DISTRIBUTION Final Report
Don R. Dickson and Franklin S. Harris, Jr. Aug. 1964 74 p refs
(Contract Cwb-10657)
(AD-605718)

A complete review of published information on droplet formation and growth, droplet distribution in fog, and the cloud

thermodynamic processes is reported. Radiative cooling was investigated, and a paper titled "Flux Divergence in a Multiple Nonscattering Atmosphere" is included. An analysis of factors in the growth of cloud or fog droplets was made following an equation that indicated that the droplet growth rate is a function of curvature, the latent heat which must be transferred from the surface of the droplet, surface tension, and salinity. It is shown that for certain ranges of radius r, the growth rate dr/dt is much less dependent on the relative humidity than had been thought. The development of a generating function by which fog droplet distributions can be approximated is reported. D.E.W.

N65-11389# Joint Publications Research Service, Washington, D.C.
THE MECHANISM OF FORMATION OF THUNDERSTORM PHENOMENA
N. S. Shishkin 25 Nov. 1964 14 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 145, 1963 p 23–29
(JPRS-27554; TT-64-51803)

Studies are reported indicating that the principal mechanism leading to the development of thunderstorm phenomena is the coagulation of charged cloud particles. The most favorable conditions for thunderstorm development exist in those clouds where the principal coagulation growth of particles occurs in a zone with a predominance of either positive or negative charging. The generation of precipitation particles in the upper part of a cloud is unfavorable for thunderstorm phenomena when there is a separation of space charges of a different sign in a vertical direction. M.P.G.

N65-11454# National Weather Satellite Center, Washington, D.C. Meteorological Satellite Lab.
TIROS PHOTOGRAPHS AND MOSAIC SEQUENCES OF TROPICAL CYCLONES IN THE WESTERN PACIFIC DURING 1962
Robert W. Fett Jul. 1964 152 p
(MSL-32)

This report contains an extensive and nearly complete series of views from TIROS V and VI of the major tropical cyclones of the Western Pacific during 1962. The relationship of the appearance of the cyclone to flow patterns suggested by cirrus striations and the direction of shear of cumulonimbus anvils, is discussed. Four stages in the development of a typhoon—tropical disturbance, tropical depression, tropical storm, and full typhoon—are defined. The storms are presented chronologically, commencing with Typhoon Iris on May 27, 1962, and ending with Typhoon Karen on November 14, 1962. D.E.W.

N65-11494* Weather Bureau, Washington, D.C.
ANALYSIS OF SPECIAL C-A-T DATA COLLECTION PROGRAM, FEBRUARY 4–9, 1963
DeVer Colson [1963] 23 p refs Presented at the 5th Conf. on Applied Meteor., Atlantic City, 2–6 Mar. 1964
(AD-447493)

This is a study of nonconvective-type turbulences at 18 000 ft MSL or higher over the continental United States. Data were gathered over a 5-day period by commercial and military pilots, and entered on flight cards equally divided into 2 1/2° latitude–longitude squares. A complete tabulation by intensity classes, flight-altitude ranges, and 12-hour time intervals for each square was made and placed on punched cards and print-outs. It was found that the probability of turbulences varied considerably across the country, with the greatest probability for both light and moderate occurrences to be over the southeast, the northwest coast, and the northern Rocky Mountains. G.G.

N65-11505# Travelers Research Center, Inc., Hartford, Conn.
PREDICTION TECHNIQUE DEVELOPMENT Summary Status Report, 1 Jul. 1963–30 Jun. 1964
H. D. Entrekin 30 Jun. 1964 35 p refs
(Contract Cwb-10704)
(AD-605153) OTS: $3.00

Continuous observations of wind and transmission were collected from mesonetwork stations from five data periods that were characterized by low cloud, fog, and precipitation. These data were supplemented by mesonet pressure observations at half-hourly intervals and by hourly weather observations. The accumulated data were used to study the space scale and movement of transmission fields for a station spacing of 0.8 to 76.0 miles. Although estimates derived for the speed of the transmission field between two combinations of stations compare favorably with the speed of the meso-low, there appears to be little relationship between the two over the entire mesonet. G.G.

N65-11508# Joint Publications Research Service, Washington, D.C.
THE PROBLEM OF THE USE OF MONOMOLECULAR FILMS FOR DECREASING THE INTENSITY OF STREAM FOGS
G. F. Prikhot'ko et al 3 Dec. 1964 7 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 11, 1964 p 27–29
(JPRS-27682; TT-64-51867) OTS: $1.00

The reduction of natural fogs by decreasing the rate of water evaporation from the surface of a body of water through the use of monomolecular films of surface-active substances is reported. Films of hexadecanol can decrease the rate of evaporation of water at a temperature of 20° to 25° C by approximately 30% to 40%. The use of such surface films to improve visibility in the neighborhood of the port of Murmansk is proposed, since laboratory studies indicate that monomolecular films are also effective at low water temperatures. M.P.G.

N65-11510# Travelers Research Center, Inc., Hartford, Conn.
SPECIFICATION OF LOW-CLOUD AMOUNT AND HEIGHT Technical Report No. 2
Duane S. Cooley May 1964 30 p refs
(Contract Cwb-10704)
(Rept.-120; AD-606572)

A study has been made of the statistical diagnosis of low-cloud amount and cloud-base height from objective analyses of observed parameters and variables derived from them. Cloud data and other atmospheric data over the central and eastern United States were analyzed on a grid mesh of approximately 52 miles. Ability to specify cloud amount and cloud height was evaluated by using screening regression analysis and testing the diagnoses on independent data. This verification on 290 cases showed that it was possible to correctly specify low-cloud amount or cloud-base height in four categories, each about 60% of the time. In addition, a comparison was made of objective cloud analyses using only station cloud observations to form initial guess fields at gridpoints, and using diagnosed and station cloud data to obtain initial guesses. The analyses were improved slightly with the use of cloud diagnoses. Author

N65-11514# Naval Postgraduate School, Monterey, Calif.
MORPHOLOGY OF UNSTABLE WAVES IN A BAROCLINIC JET
Stanley P. Lewis (M.S. Thesis) 1964 120 p refs
(AD-603431)

Solution of a system of second-order partial differential equations obtained from linearized approximations to the vorticity and thermodynamic equations yields phase velocities and amplitude functions that are utilized to compute particular solutions of the perturbation stream function field over

a net of grid points. These values are combined linearly to obtain general solutions over the entire wave, which describe the three-dimensional structure of the perturbations for selected time intervals. Equations for the particular and general perturbation vertical pressure velocities are set forth. A selection of cases representing various vertical and lateral wind profiles and static stability fields, wavelengths, and latitudes are pictured in three dimensions over a 72-hour period. Author

N65-11517# Joint Publications Research Service, Washington, D.C.
USE OF STRATOSPHERIC OBSERVATIONAL DATA IN ANALYSIS OF NATURAL SYNOPTIC SEASONS
S. T. Pagava 3 Dec. 1964 10 p Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 11, 1964 p 23–26
(JPRS-27681; TT-64-51866) OTS: $1.00

Relationships observed between the peculiarities of transition from winter cold to spring warmth in the lower stratosphere over the Arctic and the general character of spring in the western part of the U.S.S.R. and in western Siberia are discussed. These relationships are useful in weather forecasting because the character of the transition can already be determined late in the winter. The desirability of analyzing the development of atmospheric macroprocesses in the stratosphere and their relationship to tropospheric processes when compiling seasonal weather forecasts is stressed. M.P.G.

N65-11559# Chicago U., Ill.
THUNDERSTORMS AND THE LOW-LEVEL JET
William D. Bonner Oct. 1963 26 p refs Repr. from Mesometeorol. Study of Selected Areas in the U.S.
(Contract DA-36-039-SC-88932)
(AD-602540)

The relationship between the low-level jet and thunderstorm activity in the South Central United States is examined through mesoanalysis of surface data from the weather bureau and NSSP stations. Separate squall systems were found to move through Kansas and Oklahoma during the night; the systems in Kansas persisted, whereas those in Oklahoma died out. The reason for this seemed to be associated with the vertical velocity fields at low levels. It is postulated that the orientation of thunderstorms with respect to the jet maximum may be an important factor in determining whether or not they will survive for any appreciable period of time. Author

N65-11567*# Chicago U., Ill.
SYNOPTIC STUDY OF COLD AIR OUTBREAK OVER THE MEDITERRANEAN USING SATELLITE PHOTOGRAPHS AND RADIATION DATA
Aasmund Rabbe and Tetsuya Fujita Aug. 1964 38 p
(Grants NsG-333; CWB-WBG-6)
(NASA-CR-59598; SMRP-35) OTS Prices: HC $2.00/MF $0.50

Pictures and radiation data from three orbits of TIROS IV have been used to interpret the synoptic situation in connection with a cold air outbreak over the Mediterranean. Computations of divergence and vertical velocity have been made and compared with the cloud distribution obtained from the satellite photographs. Both radiation and synoptic patterns are analyzed on sigma-t charts on which the longitude and latitude lines are distorted. Author

N65-11575# Imperial Coll. of Science and Tech., London (Gt. Brit.)
STUDIES OF THE PROBLEMS OF CELLULAR CONVECTION IN THE ATMOSPHERE Final Report
Durga Ray and R. S. Scorer Aug. 1963 124 p refs
(Contract Cwb-10004)
(AD-424372)

The classical theory of convection cells in a layer of viscous fluid can be extended so as to make it more relevant to the atmosphere. When the molecular viscosity and conductivity by eddy transfer coefficients are replaced, using the classical procedure for computing the critical Rayleigh number for the onset of convection, the product $K\mu$ is determined. Assuming certain forms of spatial variation of the eddy transfer coefficients, the method of Palm can be used to study their effect on $K\nu$ and on cell shape. It is not necessary that the transfer mechanisms should be by eddies. The K-theory can be used to represent any transfer mechanism, and the effect of having highly nonisotropic transfer mechanisms is of special interest when clouds are present. There is no significant sensible heat flux through the upper surface of a convection layer in the atmosphere. Author

N65-11759# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INERTIAL NAVIGATIONAL SYSTEMS
V. S. Frolov 14 Sep. 1964 125 p refs Transl. into ENGLISH of the book "Inertsial'nyye Sistemy Navigatsii" Moscow, Voyennoye Izd. Min. Oborony SSSR, 1963 p 1–126
(FTD-MT-64-57; AD-607853)

This paper discusses operating conditions, interaction of separate units, and causes of error in inertial guidance and navigational systems. Considerable attention is given to analysis of the operation of inertial systems under conditions of space flight and to their use in the single navigational complex of an aircraft. Author

N65-11867*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
MANUAL PROCEDURE FOR DETERMINING POSITION IN SPACE FROM ONBOARD OPTICAL MEASUREMENTS
Harold A. Hamer Washington, NASA, Dec. 1964 34 p refs
(NASA-TN-D-1852) OTS Prices: HC $1.00/MF $0.50

A method is developed for manually determining a position fix in space. Basically, the method employs four nonsimultaneous angular measurements of celestial bodies, along with precalculated data for a nominal trajectory, to determine vehicle position. The method is simple and accurate, with all onboard calculations required for one position fix being adequately performed with a slide rule in less than 15 minutes. The various equations required by the navigator, as well as those essential for the precalculations, are outlined in detail. Although the method is developed and applied to earth–moon space, it could serve equally as well for interplanetary space. The important details of the method discussed are the linearity characteristics, the effect of star selection on accuracy, and the procedure to convert the nonsimultaneous measurements to a common time. Author

N65-12078*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
A SIMPLIFIED GUIDANCE SCHEME FOR ABORTING LUNAR LANDINGS
G. Kimball Miller, Jr. Washington, NASA, Dec. 1964 33 p refs
(NASA-TN-D-2504) OTS Prices: HC $1.00/MF $0.50

An analytical investigation has been made of a technique to abort the landing phase of the lunar mission. The abort technique requires only a stopwatch and an optical device for measuring the angle between the vehicle thrust axis and the line of sight to the orbiting command module. The results of the investigation indicated that the abort maneuver placed the ferry vehicle in a safe orbit that would provide rendezvous capability during the first orbital period. Thrust-angle errors of $\pm 0.5°$ were permissible if the landing trajectory was chosen so that the lunar surface in the region of the landing site contained no features that exceeded an altitude of 20 000 feet. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-10970# Fundamental Methods Associates, Inc., New York, N.Y.
FABRICATION OF SEMICONDUCTOR DEVICES BY NEUTRON TRANSMUTATION DOPING Annual Report, Dec. 1962–Dec. 1963
Carl N. Klahr and Melvin S. Cohen 31 Dec. 1963 173 p refs
(Contract AT(30-1)-3124)
(NYO-3124-1)

This report is concerned with the development of a new process for fabrication of semiconductor devices and microcircuits within a nuclear reactor, using neutron radiation as the processing tool. This process is called neutron transmutation doping. Thermal neutron reactions with the semiconductor material produce electronically active doping materials at the desired spatial locations within the semiconductor by a transmutation reaction. Experiments are described in which the principle of this concept has been proved out by fabrication of operational electronic devices in silicon using a reactor as the irradiation source. Analytical methods are given for designing simple semiconductor devices with p-n junctions by this method. A detailed quantitative analysis is given for the characteristics of the p-n junction devices produced. Author

N65-10975# Battelle Memorial Inst., Columbus, Ohio
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING AUGUST, 1964
Russell W. Dayton and Ronald F. Dickerson 1 Sep. 1964 54 p refs
(Contract W-7405-ENG-92)
(BMI-1691 (Del.)) OTS: $1.25

Progress is reported in the following areas: (1) reactor materials and components; (2) studies of fuels; (3) radioisotope and radiation applications; (4) coated-particle fuel materials; (5) corrosion studies of the fluoride-volatility process; (6) gas-cooled reactor program; and (7) development of small radioisotopic power sources. R.L.K.

N65-11041*# Pratt and Whitney Aircraft, East Hartford, Conn.
DESIGN STUDY OF A HIGH POWER IN-PILE NUCLEAR THERMIONIC SPACE POWERPLANT Final Report
A. U. Buatti and J. W. Schmitt 30 Jul. 1964 228 p refs
(Contract NASw-763)
(NASA-CR-54172; PWA-2351, Vol. 1) OTS Prices: HC $6.00/MF $1.25

The powerplant selected for design contains a thermionic reactor, a nuclear shield, a primary coolant loop, a multiple-loop heat rejection system, and a power-conditioning system. The reactor is fueled with UC-ZrC clad with a tungsten–rhenium alloy. Borated graphite and lithium-7 hydride are the materials used in the shield to protect the radiation-sensitive components in the power-conditioning equipment. The main heat-rejection system consists of 16 individual loops, each containing a radiator segment, a heat exchanger, and an electromagnetic pump. Lithium is used as the coolant and Cb-1Zr as the containment material for all components of the primary system and the main heat-rejection system. The radiators also employ Cb-1Zr as the meteoroid barrier material instead of beryllium. The power-conditioning system contains electrical equipment cooled by an auxiliary heat-rejection system employing monoisopropylbiphenyl as the coolant and aluminum as the containment material. Author

N65-12100# Air Force Inst of Tech., Wright-Patterson AFB, Ohio School of Engineering
UNCERTAINTY IN THE ESTIMATE OF POSITION AND VELOCITY ALONG A LUNAR TRAJECTORY USING INDIVIDUAL EARTH-MOON ANGULAR MEASUREMENTS IN A RECURSIVE NAVIGATION THEORY
Paul J. Ellmer and Donald R. Hefty (M.S. Thesis) Jun. 1964 37 p refs
(GGC/EE/64-9; AD-603956)

The purpose of this study is to determine the feasibility of using a recursive navigation theory in which individual earth–moon angular measurements (fixes) are processed as they are made and combined with the current best estimate of position and velocity to produce an improved estimate. The recursive navigation techniques are used. Estimates made with an earth–moon fix interval of 5 minutes or less are compared to estimates made with conventional earth–star, moon–star fixes of 15 minutes. Results show the earth–moon fix to be a feasible technique. Author

N65-12155# Radio Corp. of America, Camden, N.J. Applied Research Dept.
FEASIBILITY OF TECHNIQUES FOR A DOPPLER OPTICAL NAVIGATOR Final Report, Jun. 1963–Jun. 1964
W. J. Hannan, L. J. Nicastro, T. E. Penn, and J. Vollmer Wright-Patterson AFB, Ohio, AF Avionics Lab., Sep. 1964 142 p refs
(Contract AF 33(657)-11458)
(AL-TDR-64-209; AD-605819)

The objective was to determine the feasibility of novel laser techniques for doppler optical navigation. The ultimate performance goal is the measurement of ground speed of a satellite, traveling at a velocity of 10 000 meters per second at an altitude of 300 miles, with an accuracy of 5 meters per second. Either of two approaches can be used to instrument a doppler optical navigator—the continuous-wave approach, or the subcarrier approach. Under cw operation the receiver utilizes coherent detection techniques that suppress the effects of background noise and dark current in the photodetector. However, a cw system requires a complicated receiver, for not only must a coherent optical detector be used, but the receiver must be capable of tracking doppler shifts that could be as high as 20 Gc. On the other hand, the subcarrier approach allows the use of a relatively simple receiver, since noncoherent detection techniques can be used and since doppler shift of the subcarrier is much smaller; but it suffers from the disadvantage that neither background radiation nor dark current of the photodetector can be suppressed easily. The results of the investigation of the subcarrier approach reveal that it offers a potential advantage over a microwave system for high-altitude applications, but at the present state-of-the-art the laser transmitter power required at these altitudes cannot be realized. Author

N65-12301*# General Electric Co., Johnson City, N.Y. Light Military Electronics Dept.
OPTICAL INERTIAL SPACE SEXTANT FOR AN ADVANCED SPACE NAVIGATION SYSTEM
W. D. Foley, W. D. Gates, R. M. Derby, and J. J. Wilczynski Washington, NASA, Dec. 1964 160 p refs
(Contract NAS2-1087)
(NASA-CR-133) OTS Prices: HC $3.00/MF $1.00

An operating tracker head subsystem, consisting of dual-mode geometric optics, electrostatic vidicon, TV camera chain and data processor, was designed, built, and successfully tested. This tracker head, which is capable of precise off-axis angularity measurement in a nonnulling mode, is a logical first step in a complete space sextant system incorporating body-bound, free rotor gyroscopes as angle transducers. Author

N65-11118# Los Alamos Scientific Lab., N. Mex.
ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) Quarterly Status Report, Period Ending 20 Sep. 1964
11 Nov. 1964 23 p
(Contract W-7405-ENG-36)
(LA-3190-MS) OTS: $1.00

A maximum leakage rate of 1% for the ultra-high-temperature reactor's secondary containment structure was obtained; reactor components were investigated; the helium blower and the helium cooling system were tested; and a system analysis was performed. Neutronic calculations were performed. Some fuel elements were tested for coated particles, the effects of high-temperature irradiation, and the release of Xe^{133} from irradiated beads. G.G.

N65-11146*# Massachusetts Inst. of Tech., Cambridge
REACTIVITY CHANGES DURING STARTUP IN LARGE NUCLEAR ROCKETS
Winston W. Little, Jr. (Ph.D. Thesis) Aug. 1964 161 p refs
(Grant NsG-496)
(NASA-CR-59533; MITNE-52) OTS Prices: HC $5.00/MF $1.00

The material properties, such as core temperature, hydrogen density, etc., were computed as a function of time during startup for a specified power and flow-rate buildup. Using these time-dependent properties, the reactivity variations during startup were calculated using a diffusion theory model with 55 energy groups. The spatial dimensions were approximated by assuming $\nabla^2\phi(E) = -B^2\phi(E)$. It was found that large thermal nuclear rocket reactors (C/U = 2500) are much more sensitive to changes in hydrogen density and core temperature than small nuclear rockets (C/U = 250). The large reactivity coefficients present in thermal reactors cause both large (~−$13) and rapid (~−$1/sec) reactivity variations during the quick startups contemplated for nuclear rockets. This problem can be ameliorated to some degree by adding a nuclear poison to the core. However, any poison has the adverse side effect of decreasing the worth of an external control rod system by decreasing the leakage. An estimation of the worth of an external control rod system was obtained using a one-dimensional nucleonics model with three energy groups. Author

N65-11161# General Technologies Corp., Alexandria, Va.
RE-ENTRY BURN-UP MODEL FOR A HYDRIDED ZIRCONIUM-URANIUM FUEL ELEMENT Final Report
H. M. Childers, L. C. Mc Candless, and H. S. Jacobs Kirkland AFB, N. Mex., AF Weapons Lab., Jun. 1964 104 p refs
(Contract AF 29(601)-5907)
(WL-TDR-64-15; AD-444254)

The problem of describing the reentry behavior of a hydrided zirconium–uranium fuel element of the SNAP 2 and 10A variety in an analytical form suitable for computer application is studied with special emphasis placed on the chemical interactions of the fuel with the reentry environment. General reentry equations are presented. The trajectory and angular-motion equations are written in a form that includes effects from transpiration cooling, heats of fusion, evaporation, dissociation, recombination, chemical reactions, and mass accretion (or loss). All pertinent parameters are evaluated insofar as available data will permit. Author

N65-11174# Aerojet-General Corp., Azusa, Calif.
NUCLEAR ROCKET NOZZLE DESIGN CONSIDERATIONS
B. Mandell [1963] 30 p refs Presented at the AIAA Propulsion Meeting, Cleveland, 8 Mar. 1963

This paper includes a review of the heat-transfer correlations for hydrogen on both cooled and hot gases. These correlations are briefly summarized. The fluid conditions in the nuclear rocket are compared to the fluid conditions for which experimental data are available. The numerical treatment of these correlations as it affects design is discussed. Choice of materials in the nozzle fabrication in relation to current technology and future requirement dates is discussed. The acceptance testing procedures for a nuclear nozzle prior to utilization with the reactor are reviewed. Author

N65-11175# Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
CERAMICS RESEARCH AND DEVELOPMENT OPERATION Quarterly Report, Apr.–Jun. 1964
[1964] 110 p refs
(Contract AT(45-1)-1350)
(HW-81601) OTS: $4.00

Work is summarized under the following headings: (1) Ceramics Research—preparation and properties of plutonium compounds, stainless-steel cermets, instrumentation and facilities (dilatometers, microautoradiography, etc.), irradiation of uranium and plutonium compounds, and fission-product studies; (2) Fuels Development—PRTR and EBWR fuel fabrication, uranium oxide and plutonium oxide fuel development, pneumatic impacted and vibrationally compacted fuels, cladding studies, and containment systems and gold and lithium standards; and (3) Fuels Testing and Analysis—fuel-element performance, enriched fuel elements, cladding corrosion, and irradiation studies involving thoria and plutonium oxide. P.V.E.

N65-11194# Technical Operations Research, Burlington, Mass.
EXPERIMENTAL GAMMA RAY BACKSCATTERING BY VARIOUS MATERIALS
M. J. Barrett and J. Waldman Jul. 1964 31 p refs
(Contract OCD-OS-62-14)
(TO-B-64-68; AD-447675)

The angular distribution of Co^{60} gamma radiation backscattered from water, concrete, iron, and lead targets was measured. A collimated beam of radiation was incident at angles of 0°, 30°, and 60° to the target normal. The targets were all of sufficient thickness to simulate an infinite thickness for backscattering. Comparison of the results with the semi-empirical formula of Chilton and Huddleston

$$\left(\alpha = \frac{CK(\theta_s)\,10^{2\theta} + C'}{(1 + \cos\theta_0 \sec\theta)}\right) \quad (1)$$

for differential dose albedo from concrete showed good agreement. The results for iron were fit to a function of the form (1). Results indicated that the constants C and C' for 1.25-MeV photons incident on iron may be taken as 0.0596 and 0.0066, respectively. A modification of (1) to account for the difference in the absorption coefficients for incident and backscattered radiation provided an improved fit to the data. Author

N65-11225# Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
AN ISOTOPE GAMMA SOURCE FOR CLAD THICKNESS MEASUREMENTS AND URANIUM CONTAMINATION DETECTION
R. B. Jacob Jul. 1964 14 p ref
(Contract AT(45-1)-1350)
(HW-83458) OTS: $1.00

The possibility of using a gamma emitter (an Ir^{192} source) for detecting small quantities of uranium or for measuring the thickness of a metal cladding overlying a uranium fuel core was investigated. Experimental results indicate that an iridium source should be as good as, if not better than, the

X-ray machine now in use for contamination testing. In addition, this source allows the measurement of zirconium cladding up to a thickness of about 0.1 in. The slope of the cladding-thickness attenuation curve is approximately 400 counts/sec/0.001 in., which should allow the development of a very accurate cladding thickness tester or primary standard. M.P.G.

N65-11269# Atomics International, Canoga Park, Calif.
1000-Mwe SGR CORE OPTIMIZATION STUDIES
H. Rood 15 Oct. 1964 53 p ref
(Contract AT(11-1)-GEN-8)
(NAA-SR-9501) OTS: $1.25

The fuel material is hypostoichiometric UC, clad in sealed stainless steel tubes, sodium bonded. The average discharge exposure assumed attainable with this fuel, at a maximum center temperature of 2000° F, is 25 000 MWd/MTU. The four parameters taken as independent variables for the optimization study are fuel rod diameter, number of fuel rods per element, fuel element lattice spacing, and maximum fuel temperature. The optimization study was limited to the reactor core by fixing the coolant inlet and outlet temperatures at reasonable values determined by previous studies. Some of the other fixed parameters are cladding material and thickness, process tube material and thickness, core length, pressure drop, maximum fuel exposure. Given these parameters and a value for each of the independent variables, all other core parameters were calculated. Author

N65-11336# Oak Ridge National Lab., Tenn.
REACTOR CHEMISTRY DIVISION ANNUAL PROGRESS REPORT Period Ending 31 January 1961
R. E. Thoma et al 12 May 1961 186 p refs
(Contract W-7405-ENG-26)
(ORNL-3127)

The Molten-Salt Reactor Program research reported includes high-temperature phase equilibrium studies, precipitation of oxides from molten fluorides, solubility of gases in molten salts, xenon poisoning in Molten-Salt Reactors containing graphite, thermodynamic studies in molten salts, radio-tracer techniques in a study of INOR-8 alloy corrosion by molten fluorides, behavior of fission products in a graphite–molten salt system, and purification and handling of molten salts. Aqueous Reactor Program research reported includes aqueous systems at elevated temperature, reactions in aqueous solutions, investigation of uranium (VI) hydrolysis at elevated temperatures using the glass electrode, isopiestic studies at elevated temperatures, surface chemistry of thoria in dilute aqueous electrolytic solutions, corrosion by solutions, corrosion by solutions under irradiation, and slurry corrosion and blanket materials tests. Support for high-temperature solid-fueled reactors reported includes transport of noble gases in graphites, evolution of gas from graphite, measurement of temperature in reactor environments, removal of gaseous radioactive fission products from other gases, release of fission products on in-pile melting of reactor fuels, and effect of radiation on beryllium oxide. The preparation and properties of reactor materials are also presented. M.P.G.

N65-11364# Atomics International, Canoga Park, Calif.
TEMPERATURE OSCILLATIONS IN THE SRE
C. L. Peckinpaugh 15 Oct. 1964 34 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10151)

Fuel-element temperature oscillations were observed as the power level of the SRE, with the second core loading of thorium–uranium fuel, was increased to 50% of full power. The maximum amplitude of oscillations observed (100 F° peak-to-peak) approached allowable limits imposed by stress analysis. Modifications of the fuel elements by spreading apart the rod bundle reduced oscillation amplitudes by a factor of three or more, and thus permitted safe increase of the reactor to full power with a general reduction in the amplitude of oscillations. Extensive experimental work, including measurements with an experimental bowable fuel element, conclusively demonstrated that motion of the entire fuel cluster within the coolant channel was the principal cause of temperature oscillations in the Core II fuel element. Author

N65-11392# Joint Publications Research Service, Washington, D.C.
CONSTRUCTION MATERIALS FOR THE ACTIVE ZONE OF NUCLEAR REACTORS
A. S. Zaymovskiy, V. V. Kalashnikov, and I. S. Golovnin 30 Nov. 1964 94 p refs Transl. into ENGLISH from the book "Teplovydelyayushchiye Elementy Atomnykh Reaktorov" Moscow, 1962 p 71–159
(JPRS-27593; TT-64-51821)

The physical and the mechanical properties, and the general characteristics of construction materials for the jackets of fuel elements in nuclear reactors were investigated. The following topics are discussed: "Thermal Fatigue of Construction Materials"; "Compatibility of Construction Materials with Fuel and Corrosion in Coolants"; and "Influence of Neutron Irradiation on Construction Material." G.G.

N65-11473# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE DYNAMICS OF NUCLEAR POWER INSTALLATIONS
P. A. Gavrilov and B. N. Seliverstov 22 Apr. 1964 13 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 15, no. 2, Aug. 1963 p 115–120
(FTD-MT-63-342; AD-602587)

The results are compared of experimental and theoretical investigations of the dynamic characteristics of the technological stand of the Beloyarskaya atomic power station with a nuclear superheating of steam. The validity of a number of simplifying assumptions frequently applied in the consideration of the dynamics of nuclear-power installations is proven. Results of the investigations can be used for theoretical analysis of the dynamic characteristics of certain types of nuclear-power installations, and also for the analysis and synthesis of optimum systems of control. Author

N65-11519# General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
REENTRY AND DISPOSAL PHENOMENA FOR NUCLEAR AUXILIARY POWER SYSTEMS Final Report
Kirtland AFB, Ohio, Res. and Technol. Div., Nov. 1963 304 p refs
(Contract AF 29(601)-4893)
(AE-63-0143; RTD-TDR-63-3003; AD-424400)

This report examines several phenomena associated with the reentry from orbit of a satellitebome nuclear-power source and the subsequent dispersal of radioactive debris. Obvious hazards to the civilian population in the dispersal areas motivated this study. The immediate purpose was to establish the possibility that reentry through the atmosphere would cause the nuclear-fuel elements to incinerate, and thereby to be rendered innocuous. Several configurations were included in the detailed hypotheses, including rods, cylinders, and random asymmetric shapes; all of them were studied under the many parameters of reentry phenomena. Included are test data from the debris of a satellite booster that placed a Mercury capsule in orbit in 1962. While a large volume of data in many parameters was derived, no definitive conclusions were reached. It is indicated, however, that incineration alone is not a sufficient guarantee that the hazards of radioactive-fuel deposition on earth have been eliminated. Author

N65-11524# Battelle Memorial Inst., Columbus, Ohio
AN EVALUATION OF PLUTONIUM COMPOUNDS AS NUCLEAR FUELS
William M. Pardue, Victor W. Storhok, Roy A. Smith, and Donald L. Keller 29 Oct. 1964 39 p refs
(Contract W-7405-ENG-92)
(BMI-1698) OTS: $1.00

Nuclear and materials properties of interest were considered in defining the most attractive plutonium compounds for use in thermal and fast reactors. Some consideration was also given to the use of these compounds in radioisotope heat sources. After a process of elimination, the most promising compounds included PuN, PuO_2, PuC, PuS, PuP, $PuAl_2$, $PuSi_2$, PuAs, PuTe, and PuB. Cursory experimental studies on the systems plutonium–arsenic, plutonium–phosphorus, and plutonium–silicon were carried out, and certain phase relationships were defined. Tentative phase diagrams of the arsenide and phosphide systems were drawn. Single-phase PuP specimens were prepared. Author

N65-11625# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUCLEAR ENERGY (SELECTED ARTICLES)
17 Jul. 1964 28 p refs Transl. into ENGLISH from Kernenergie (Dresden), v. 6, no. 7, 1963 p 300–310
(FTD-TT-64-159/1+2; AD-446785)

A description is given of the zero power reactor finished last year. Special data on the design are to be found in other contributions in this series of articles. A special section is devoted to the application possibilities of the reactor for reactor–physical research work. Author

N65-11792# AiResearch Mfg. Co., Los Angeles, Calif.
FORCED-CONVECTION VAPORIZATION OF POTASSIUM IN A SINGLE TUBE
P. J. Berenson Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Nov. 1964 150 p refs
(Contract AF 33(615)-1551)
(APL-TDR-64-115; AD-608075)

This report describes work undertaken to resolve uncertainties in the forced-convection vaporization characteristics of potassium that affect the SNAP-50/SPUR boiler design. A review is presented of liquid-metal and forced-convection vaporization heat transfer. The test program and single-tube boiler developed to measure liquid and high-vapor-quality potassium heat transfer coefficients are described. Finally, the data processing procedure and results of the test program are described and discussed. The major conclusions were that, with a twisted-tape insert in the tube, the quality beyond which the heat transfer coefficient decreases very rapidly, due to the formation of dry spots, is 80 to 90 percent, and the heat transfer coefficient beyond this quality remains an order of magnitude greater than the corresponding dry-vapor coefficient. Author

N65-11798# Oak Ridge National Lab., Tenn. Neutron Physics Div.
PULSE-HEIGHT SPECTRA OF GAMMA RAYS EMITTED BY THE STAINLESS-STEEL-CLAD BULK SHIELDING REACTOR II (BSR-II)
G. T. Chapman, K. M. Henry, and J. D. Jarrard Nov. 1964 57 p refs
(Contract W-7405-ENG-26)
(ORNL-3609) OTS: $3.00

Measurements have been made of the pulse-height spectra of gamma rays emitted from the core of the Bulk Shielding Reactor II (BSR-II). Preliminary analysis of the data indicates that the gamma rays having energies above 5 MeV originate primarily from thermal-neutron capture in the stainless steel reactor structure. Below 5 MeV the spectrum is apparently composed of the expected continua of prompt-fission and fission-product gamma rays, with a large contribution from thermal-neutron captures in the hydrogen of the water that moderates and reflects the core. Except for reduced intensity, little change was noticed in the structure of the distribution as the amount of water between the reactor surface and the spectrometer was increased from 1 to 60 cm. Author

N65-11883# North American Aviation, Inc., Downey, Calif. Space Sciences Lab.
A STUDY OF THE FEASIBILITY OF USING NUCLEAR VERSUS SOLAR POWER IN WATER EXTRACTION FROM ROCKS Scientific Report No. 1
J. Green 31 Jul. 1964 256 p refs
(Contract AF 19(628)-3292)
(AFCRL-64-733; AD-608225)

The water content and optimum water yield within certain temperature ranges is discussed for six rock standards relative to nuclear and solar water extraction systems. These chemically and petrographically described standards include tholeiitic basalt, semiwelded tuff, obsidian, altered rhyolite, serpentine, all from Oregon, and granodiorite, from California. Techniques for water analysis include chemical, differential thermal analysis, electrolytic hygrometry, and static dehydration. SNAP reactors can easily meet the energy requirements of a water extraction unit providing 4 kg (9 lb) of water per hour. Four of the seven types of rocks required less than 100 kW of thermal energy. Although peak temperatures for some rocks may be a problem, this would be handled by operating at the upper limit of the reactor with only a small sacrifice in the yield of water. Two types of reactor installations are possible: a buried installation and an integral earth fabricated shield. The heat transfer requirements of the dehydrator are given for seven types of rocks, and a preliminary design of the unit is presented for one of these cases. Author

N65-11926# Nuclear Utility Services, Inc., Washington, D.C.
ENVIRONMENTAL SAFETY ASPECTS OF NUCLEAR ROCKET FLIGHT OPERATIONS Annual Progress Report
C. Rogers Mc Cullough Jun. 1964 240 p
(Contract SNPC-6)
(NUS-179)

Refinement of the earlier analysis of the environmental safety aspects of nuclear-rocket flight operations was characterized by two factors—first, the incorporation of the most recent data available from programs within and without the ROVER program; and second, the programing of the hazard analysis for IBM-7090/7094 computation. The computer program is very comprehensive, incorporating within it the capacity for source, environmental, and biological transfer of some 187 fission products. Special studies were conducted beyond the scope of the NERVA/RIFT safety context; the most significant was concerned with the hazards associated with the operational use of NERVA-type engines. The core material is one that does not lend itself to complete burnup upon reentry, and, therefore, the probabilities and effects of interaction of returning particles with the population were examined. D.S.G.

N65-11936# Oak Ridge National Lab., Tenn. Reactor Div.
THE MPRE—A BOILING POTASSIUM REACTOR SYSTEM
Arthur P. Fraas *In its* Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 1–2 (See N65-11935 02-33) OTS: $7.00

The Medium Power Reactor Experiment (MPRE) is briefly described as typical of applications requiring heat-transfer and fluid-dynamic data on the forced-convection boiling of liquid metals. Previous reactor systems studies indicated that, for a

given peak system temperature, a Rankine vapor cycle offers minimum size and weight for turbine-generator nuclear space powerplants. Reliability and layout studies favored a single-fluid system using potassium to cool the reactor, carry out the thermodynamic cycle, and lubricate the bearings. The single-fluid system makes it possible to obtain a system weight of about 25 lb/kWe in a stainless-steel system with potassium boiling in the reactor at 1540° C. Further, this system permits operation in the 1000° to 2000° F range at relatively low system pressures of 30 psia at 1550° F. The remaining serious problems are those associated with boiling flow stability. A general analytical solution has been worked out for a simplified system, and more complex systems are being studied, both with an analog computer and with test rigs that, from the hydraulic standpoint, closely simulate full-scale powerplant proportions. M.P.G.

N65-11943# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

LITHIUM-BOILING POTASSIUM REFRACTORY METAL LOOP

Jerry P. Davis, Gerald M. Kikin, Wayne M. Phillips, and Lawrence S. Wolfson 1 Aug. 1963 *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 171–193 (See N65-11935 02-33) OTS: $7.00

The loop is totally constructed of columbium-1% zirconium alloy and will operate at temperatures up to 2100° F. The primary purposes of this loop facility are to investigate overall transient and steady-state characteristics of a two-loop system that approximately simulates velocities, temperature, pressures, transit times, and heat fluxes in the range of actual system interest. The primary loop heat source is by direct-resistance heat generation in a section of tube wall and liquid metal, which lends itself to programing of reactor kinetic equations for simulation of power response to various system perturbations. Steady-state local-boiling heat-transfer coefficients and two-phase pressure-drop data will also be obtained for a variety of operating parameters. Author

N65-11951# Argonne National Lab., Ill.

REACTOR DEVELOPMENT PROGRAM Monthly Progress Report, Oct. 1964

R. M. Adams and A. Glassner 15 Nov. 1964 109 p refs
(Contract W-31-109-ENG-38)
(ANL-6965) OTS: $4.00

The following topics are presented in addition to the general basic subjects: "Sodium Coolant Chemistry"; "High-temperature Materials Development"; "Heat Engineering"; "Magnetohydrodynamics"; and "Regenerative Emf Cells." G.G.

N65-12251# HRB-Singer, Inc., State College, Pa.

NUCLEAR RADIATION EFFECTS ON GE:HG AND GE:CU IR PHOTOCONDUCTORS

George Martzin, Don Brown, and John P. Walker, Jr. (Ling-Temco-Vought, Inc.) 29 May 1964 29 p refs
(S-87)

This paper describes the results of a radiation effects testing program of 10 long wave IR photoconductors—5 Ge:Cu and 5 Ge:Hg. The objective of the tests was to determine gamma and neutron rate effects on the production of noise in the IR photoconductors and to determine the effect of total integrated dose on photoconductor performance. The results of these tests were as follows. First, the noise produced by gamma radiation is flat and becomes significant with respect to normal ambient background noise at gamma dose rates of 10 to 100 R/min and increases as the square root of the gamma dose rate thereafter. Second, noise produced by neutron rates of 10^8 neutrons/cm^2/sec is such that it is completely masked by gamma dose rates of 150 R/min. Third, the detectivity of all of the 10 photoconductors declined by a factor of between 3 and 4 at integrated doses of 5×10^{14} neutrons/cm^2 ($E > .3$ MeV) for 7 of the 10 photoconductors and a factor of approximately 10 for the other 3 (but 2 of these 3 started out having poorer detectivity). Fourth, the most significant factor affecting the design of an IR system operating in the nuclear radiation environment is the large change in resistance of the photoconductor with integrated dose, and a correspondingly large change in photoconductor responsivity. Author

N65-12296# Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.

APPROACH TO CRITICAL AND CALIBRATION EXPERIMENTS IN THE PLUTONIUM RECYCLE CRITICAL FACILITY

R. A. Bennett and L. C. Schmid Jul. 1964 51 p refs
(Contract AT(45-1)-1350)
(HW-80206) OTS: $3.00

This report describes the initial approach to critical experiment and power level, control rod, and moderator-level calibration experiments in the plutonium recycle critical facility when it is moderated with D_2O. The longitudinal- and radial-flux distribution was measured and compared to analytical results, using the three-group diffusion theory. G.G.

N65-12299# Naval Research Lab., Washington, D.C. Metallurgy Div.

IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS Quarterly Progress Report, 1 May–31 Jul. 1964

L. E. Steele, J. R. Hawthorne, and C. Z. Serpan, Jr. 15 Aug. 1964 41 p refs
(NRL-MEMO-1556; AD-447973)

This report includes data on the following: (1) microstructural examination of uranium-bearing steels; (2) comparison of effects of simultaneous irradiation of six structural steels; (3) radiation damage surveillance of Yankee Atomic Power Plant pressure vessel; (4) activation of the new high-level radiation laboratory; and (5) techniques and equipment for in-reactor studies of low-cycle fatigue of metals. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-10960# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Mülheim an der Ruhr (W. Germany)

ON PERIODIC SOLUTIONS OF NON-LINEAR EQUATIONS OF VIBRATION [EIN BEITRAG ZUR FRAGE DER PERIODISCHEN LOSUNGEN NICHTLINEARER SCHWINGUNGSGLEICHUNGEN]

W. Thielemann and G. Kotowski Jul. 1964 50 p refs In GERMAN; ENGLISH Summary
(DVL-311; DLR-FB-64-07) Available from Zldi, Munich: DM 22

In a preceding report certain types of steady oscillations of a nonlinear one-degree-of-freedom system with a cubic spring characteristic (with increasing stiffness) and a harmonic disturbing force were studied. Subharmonic oscillations with a marked higher harmonic were investigated in particular. This report deals with an analogous problem, but the type of spring characteristic is a linear spring with

a dead zone (free play). Solutions are determined exactly. For a given value of the amplitude of the disturbing-force, undamped superharmonic oscillations of second and third order and several branches of subharmonic oscillations with twice the period of the disturbing force are calculated using digital computers. Response curves are obtained with an analog computer for two different values of the amplitude of the disturbing force; a little damping is included. Author

N65-11051*# Illinois U., Urbana Coordinated Science Lab.
PROGRESS REPORT FOR MARCH, APRIL, AND MAY 1964
20 Jul. 1964 111 p refs
(Grants NsG-376; NsG-443; NsG-504; Contracts DA-28-043-AMC-00073(E); AF 49(638)-1383)
(NASA-CR-59497; AD-603025) OTS Prices: HC $4.00/MF $0.75

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3. COMPUTER R. M. Brown et al p 32–37
4. SYSTEMS M. E. Van Valkenburg et al p 38–54 refs
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8. HIGH MAGNETIC FIELD SUPERCONDUCTORS C. B. Satterthwaite et al p 80–88 (See N65-11055 02-26)
9. HIGH VOLTAGE BREAKDOWN D. Alpert et al p 89–90 ref
10. EVAPORATED THIN FILMS R. N. Peacock et al p 91–98 refs (See N65-11056 02-26)

N65-11062# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ABOUT CERTAIN CASES OF ABILITY OF EQUATIONS OF GYROSTAT MOTION TO BE INTEGRATED
L. N. Sretenskiy 10 Feb. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 149, no. 2, 1963, p 292–294
(FTD-MT-63-230; AD-602554)

A heavy, solid body secured at one point is considered. It is assumed that a certain axis is connected with this body, around which a uniform flywheel can revolve. Taking the designation of solid-body dynamics and designating the projections of the angular momentum of the flywheel on a moving axle, the integral equations of motion for two particular cases are formed. One case is connected with a Goryachev Chaplygin gyroscope and the other with the Appelrot theory. It was found that a straight line proceeding from the point of rest to the center of gravity of a gyrostat moves in space as does the axis of a Lagrange gyroscope. The equation for the angle of the natural rotation can be applied to the Riccati equation and then to the linear second-order differential equation with biperiodic coefficients. G.G.

N65-11068# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
RESEARCH ON TECHNIQUES FOR LIGHT MODULATION DETECTION. PART II: FREQUENCY DEMODULATORS Final Report, 15 May 1963–15 May 1964
E. O. Ammann, S. E. Harris, and R. Targ Wright-Patterson AFB, Ohio, AF Avionics Lab., Jun. 1964 246 p refs
(Contract AF 33(657)-8995)
(AL-TDR-64-181, Pt. II; AD-605512)

This report summarizes the results of a program on the demodulation of frequency-modulated (FM) or phase-modulated (PM) light. Theoretical and experimental studies were made of both direct demodulation and of heterodyne demodulation, with emphasis on the former. The majority of the report deals with techniques and devices for converting FM (and PM) to AM at optical frequencies. Comprehensive analyses and discussions are given on two simple birefringent devices—the birefringent discriminator and the optical ratio detector. These devices are capable of converting FM to AM and PM to AM, respectively. In addition, the use of multicrystal devices in demodulators is treated. Included are two optical network synthesis techniques for realizing birefringent devices having arbitrarily specified transfer functions. The conclusions reached in this program are stated, and the major contributions are summarized. Author

N65-11223# New York U., N.Y. Courant Inst. of Mathematical Sciences
THE ENERGY DECAY OF SOLUTIONS TO THE INITIAL-BOUNDARY VALUE PROBLEM FOR THE WAVE EQUATION IN AN INHOMOGENEOUS MEDIUM
B. B. Lieberman Jun. 1964 21 p refs
(Grant AF-AFOSR-537-64)
(BR-45; AFOSR-64-1642; AD-605508)

The paper is concerned with the decay of the energy of disturbances that are propagated according to the wave equation with variable index of refraction in the exterior of a finite star-shaped reflecting body. It is shown that the energy of the disturbance decays like some power of t^{-1}. Certain conditions of growth and continuity are made on the index in order to insure some decay factor. The energy decay is obtained by estimating the solution of an integral equation that results when one applies the Friedrichs' A-B-C method to the modified wave equation operator. Using the energy estimate with other familiar estimates, one obtains a rate of decay for the disturbance itself. Author

N65-11297# Queens Coll., Flushing, N.Y.
ROTATING OBJECTS IN CONFORMALLY FLAT SPACES
A. L. Harvey Sep. 1964 9 p refs
(Grant Nonr(G)-00055-64)
(TR-2; AD-447484)

Presented is the reconstruction of an unpublished argument in which Einstein showed that the first Nordström theory of gravitation was faulty because a rotating object would fall with less acceleration than a nonrotating object in a static, homogeneous gravitational field. It is further shown that the defect is common to any theory of the Nordström type. P.V.E.

N65-11350# Naval Research Lab., Washington, D.C.
THE NUMERICAL COMPUTATION OF RADIATION IMPEDANCE OF ZONAL ARRAYS ON A HARD PROLATE SPHEROIDAL BAFFLE Interim Report
S. Hanish 27 Jul. 1964 21 p refs
(NRL-6108; AD-605276)

The mechanical radiation impedance between tesseral-section sound sources in an acoustically hard prolate spheroidal baffle is analyzed, and formulas are derived for calculating the impedance in terms of prolate spheroidal wave functions. The particular case of the interaction between zonal sound sources is treated in detail. A complete numerical study is made of the interaction between eight zones on prolate spheroidal baffle 2.3λ long having a radius a at the equator such that $ka \approx 3$. The zones have an axial height of $\lambda/10$ and are spaced $\lambda/10$ units apart. Theoretical radiation-impedance interaction coefficients are calculated, and tables are presented of mutual and self-impedances of all eight zones. Theoretical acoustic

beam patterns are calculated and plotted for the condition of equal zonal surface velocities. Author

N65-11472# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON SPECTRUM OF HARMONIZED DYNAMIC SYSTEMS
M. I. Grabar' 17 Apr. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 109, no. 4, 1956 p 687–689
(FTD-MT-63-330; AD-605914)

Two dynamic systems are considered on an r-dimensional torus R with cyclical coordinates $x_1, ..., x_r$ taken with respect to mod 2π. The two systems are determined by the following systems of differential equations: $dx_k/dt = \alpha_k$ (1) $dx_k/d_\tau = \alpha_k/F(x)$ (k = 1, 2, ..., r) (2), where $\alpha_1, \alpha_2, ..., \alpha_r$ are rationally independent real numbers, and $F(x) = F(x_1,...,x_r)$ is a positive real continuous function, periodic with respect to every variable with a period of 2π. The spectrum of system (2) is extended to the case of arbitrary r. M.P.G.

N65-11493# Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
QUARTERLY PROGRESS REPORT NO. 75
H. J. Zimmermann and G. G. Harvey 15 Oct. 1964 244 p refs (Contract DA-36-039-AMC-03200(E))

Research results are reported in the following areas: (1) radio physics, including microwave spectroscopy, radio astronomy, far infrared spectroscopy, geophysics, magnetic resonance, and physical acoustics; (2) plasma dynamics, including plasma physics, plasma eletronics, and plasma magnetohydrodynamics, and energy conversion; and (3) communication sciences and engineering, including statistical communication theory, linguistics, cognitive information processing, communications biophysics, neurophysiology, neurology, and network synthesis. M.P.G.

N65-11580# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE OPERATION OF A FOUR-LEVEL OPTICAL QUANTUM GENERATOR
Yu. A. Anan'yev, V. F. Yegorov, A. A. Mak, D. S. Prilezhayev, and B. M. Sedov 3 Feb. 1964 10 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 44, no. 6, 1963 p 1884–1888
(FTD-MT-63-229; AD-605870)

The properties of a four-level optical quantum generator are theoretically and experimentally investigated. Conditions are found of a transition from four-level to three-level generation in the generator on $CaF_2:U^{3+}$ base. Author

N65-11611# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PECULIARITIES OF DYNAMIC WEIGHTLESSNESS
V. Selyakov [1964] 10 p Transl. into ENGLISH from RUSSIAN
(FTD-MT-63-19; AD-602571)

Three gravitational areas in a satellite, as well as in a high-altitude rocket, are considered, and it is concluded that the peculiarities of dynamic weightlessness will appear in a vacuum inside a rocket only if significant centrifugal forces are absent. G.G.

N65-11624# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TRANSPARENCY OF GASES IN THE INFRARED PART OF THE SPECTRUM FOR SMALL DISTANCES
B. P. Kozyrev and A. V. Mezenov 13 May 1964 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 3, 1963 p 18–22
(FTD-MT-64-41; AD-602896)

An installation for the investigation of the absorption of infrared rays in gases is described. Experimental data on the influence of distance and humidity on the transparency of small thicknesses of room air for several regions of wavelengths in an interval from 15μ to 200μ are presented. Author

N65-11655# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONFERENCE OF THE ACTION OF IRRADIATION ON A SUBSTANCE
N. F. Pravdyuk, Yu. N. Pokrovskiy, and P. A. Platonov 19 Jul. 1963 18 p Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 13, no. 6, 1962 p 608–609
(FTD-MT-63-71; AD-606256)

Reports on the theory of radiation damage of materials, the influence of neutron irradiation on certain construction materials, and on pure metals and semiconductors are discussed. This is a very general conference report. G.G.

N65-12006# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
SLUSH HYDROGEN
Gus J. Caras 22 Sep. 1964 50 p refs
(RSIC-288; AD-451143)

Production of slush hydrogen by vacuum pumping of liquid hydrogen is the most practical method, considering capital investment and operating costs. Injection of cold-helium gas was determined to be the most promising method for increasing the solid content of slush hydrogen after transfer to the flight-vehicle tanks. Work currently underway includes research on the rheologic and thermodynamic properties of slush hydrogen and research on production techniques for obtaining relatively high percentages of solid in slush hydrogen. Author

N65-12027# Israel Inst. of Technology, Haifa
COMMUTATION RELATIONS FOR ENERGY-MOMENTUM TENSOR Scientific Report No. 4
A. Peres Wright-Patterson AFB, Ohio, ARL, 28 Apr. 1964 6 p refs
(Contract AF-EOAR-64-20)
(ARL-64-165; AD-605494)

Schwinger's formula for $[T^{00}(x), T^{00}(y)]$ cannot be generalized, in a covariant fashion, to the other components of the energy-momentum tensor. Author

N65-12098 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SECOND ALL-UNION CONGRESS ON THEORETICAL AND APPLIED MECHANICS (ABSTRACTS OF PAPERS)
G. K. Mikhaylov, ed. 30 Jul. 1964 287 p refs Transl. into ENGLISH of the book "Vtoroy Vsesoyuznyy Syezd po Teoreticheskoy i Prikladnoy Mekhanike" Moscow, Akad. Nauk SSR, 1964 p 1–246
(FTD-MT-64-207; AD-602906)

Abstracts are presented of papers presented at a Russian conference on theoretical and applied mechanics. The abstracts are placed in the alphabetic order of the authors' names. The three major sections of the congress were general and applied mechanics, fluid and gas mechanics, and the mechanics of solids. D.E.W.

N65-12188# American Optical Co., Southbridge, Mass. Research Div.
GRADIENT DENSITY SUNGLASSES Final Report, Aug. 1962–Apr. 1964

Helen Jupnik Wright-Patterson AFB, Ohio. Systems Eng. Group, Oct. 1964 128 p refs
(Contract AF 33(657)-9681)
(SEG-TDR-64-50; AD-608299)

Lenses having a neutral absorbing base with a nominal density of 0.52 and lenses having a clear base were coated with a gradient layer of titanium suboxide and antireflected by a uniform film of magnesium fluoride to produce neutral gradient density sunglasses. Within acceptable limits, the density varied linearly from about that of the uncoated substrate at the bottom of the lens to 2.5 ±0.3 at the top of the lens. The coatings were deposited on the concave surface of all lenses, and the contra-ocular surface remained uncoated. The back reflectance measurements that were made on a number of lenses averaged the reflectance over an area 12 mm in diameter. The reflectance minima measured varied from 1% to 3% over the various areas of lenses from different production cycles, and if the minimum was located between 500 and 600 mμ, the reflectance could rise to about 8% at 400 mμ and 6% at 750 mμ. Author

N65-12221# Aerojet-General Corp., Downey, Calif. Ordnance Div.
INVESTIGATION OF ELECTRIFICATION OF POWDERS IN FLOW THROUGH TUBES AND NOZZLES. I: A CHARGE ANALYZER
T. G. Owe Berg, G. C. Fernish, and W. J. Flood 3 Jun. 1963 45 p refs
(Contract DA-18-108-405-CML-829)
(Rept.-0395-04(08)SP; AD-449189)

As a part of an investigation of the electrification of powders in flow through tubes and nozzles, a charge analyzer has been designed, constructed, and tested. The charge analyzer has two electrodes at ±1000 volts with respect to ground. At a stationary state the current from each electrode is equal to the rate of deposition of charge. The two currents are recorded and integrated with a planimeter. The electrodes are weighed on a microbalance for determination of the amount deposited. The nozzle is located at one end of the pair of electrodes. Experiments have been conducted with several airborne powders, in the range 1μ to 30μ of particle diameter, flowing through a hypodermic needle of 0.8-mm diameter and 3-ft length of flow rates between 50 and 500 cc/mm. The average positive charge, the average negative charge, and the average absolute charge are proportional to the square of the flow rate. The charge is acquired in friction between the powder particles and a deposit on the tube wall. Author

N65-12236# RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING, PARTICLE INTERACTION AND CONSERVATION RELATIONS
Richard Bellman and Sherman Lehman Sep. 1964 25 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3816-PR; AD-606231) OTS: $1.00

In previous papers, a detailed analysis of the ordinary and partial differential equations of invariant imbedding was given, concentrating upon existence and uniqueness of solution, nonnegativity of solution, and convergence of associated difference algorithms as step size went to zero. In this paper, it is shown that for a quite general class of transport processes involving particle-particle interaction, as well as the usual particle–medium interaction, difference approximations can be obtained that exhibit nonnegativity and boundedness in an immediate fashion. Furthermore, a uniform Lipschitz condition is preserved. Author

N65-12242# Naval Scientific Technical Information Center, London (Gt. Brit.) Research and Development Services Dept.
SYSTEMATIC ERRORS IN THE DETERMINATION OF OPTICAL FINISH BY MEANS OF FIZEAU INTERFERENCE
E. Einsport Jun. 1964 18 p refs Transl. into ENGLISH from Optik (Stuttgart), v. 4, no. 1, 1948 p 11–21
(NSTIC-Trans-1499; AD-445148)

This paper concerns the use of Fizeau's interference method for surface tests on optical plates. The basic relationships contain errors necessitating the development of practical equations that are strictly valid. These are formed. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-11003*# California U., Berkeley Space Sciences Lab.
INVESTIGATION OF KILOVOLT ION SPUTTERING
Second Quarterly Progress Report
Harold P. Smith, Jr. and N. Thomas Olson 31 Oct. 1964 30 p refs *Its* Ser. 5, Issue 64
(Contract NAS3-5743)
(NASA-CR-54128) OTS Prices: HC $2.00/MF $0.50

Electrostatic electron-beam focusing techniques have been successfully applied to 2- to 4-keV cesium ion beam transmission. Normal bombardment of a neutron-activated copper crystal (001 face) and gamma counting of the sputtered particles shows that the sputtering yield increases with ion energy from 8.9 atoms/ion at 2 keV to 14.5 atoms/ion at 4 keV. A quadrapole mass spectrometer has been combined with the ion source to successfully detect sputtered copper atoms. An ultra-high-vacuum system has been constructed and operated at 10^{-9} torr, and the pulse-height spectrum of the spectrometer output has been measured. Author

N65-11015# Oak Ridge National Lab., Tenn. Neutron Physics Div.
STATISTICAL MODEL CALCULATIONS OF NUCLEON-NUCLEON AND PION–NUCLEON COLLISIONS: CENTER-OF-MASS SPECTRA
R. G. Alsmiller, Jr. Nov. 1964 42 p refs
(ORNL-3713) OTS: $2.00

Statistical model results for nucleon-nucleon and pion–nucleon collisions are presented for a variety of cases. All calculations were carried out using noncovariant phase space integrals. In specifying final states, only states containing nucleons, nucleon isobars (mass = 1.31 nucleon masses, spin = 3/2, isotopic spin = 3/2), and pions were considered. Nucleon and pion energy spectra are given for nucleon-nucleon collisions having total c.m. energies ranging from 2.388 to 5.030 nucleon rest energy, and for nucleon lab kinetic energies ranging from 0.80 to 10.00 GeV. Nucleon and pion energy spectra are presented for pion–nucleon collisions with the following energy ranges: total CM energy—1.738 to 4.756 nucleon rest energy, and pion lab kinetic energy 0.80 to 10.00 GeV. P.V.E.

N65-11053*# Illinois U., Urbana Coordinated Science Lab.
SURFACE AND ATOMIC PHYSICS
F. Propst et al *In its* Progr. Rept. for Mar., Apr., and May 1964 20 Jul. 1964 p 21–31 refs (See N65-11054 02-23) OTS Prices: HC $4.00/MF $0.75

Work is reported on the adsorption of gases on tungsten and on the angular distribution of Auger electrons. A technique is described that uses secondary emission of electrons by low-energy incident ions to measure the degree of surface

coverage. An apparatus was designed to measure Auger neutralization, electron diffraction, and secondary electron emission for any given crystalline surface in situ. D.E.W.

N65-11133# Philips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
SCINTILLATION SPECTROMETRY. γ-RAY SPECTRUM CATALOGUE, VOLUME I
R. L. Heath Aug. 1964 369 p refs 2d ed.
(Contract AT(10-1)-205)
(IDO-16880-1) OTS: $10.00

This edition is a complete revision of the original data compilation, that was issued as an AEC R and D Report (IDO-16408) in 1958. As in the original catalogs, this edition contains a collection of spectra representing the response of a scintillation spectrometer to individual radioactive nuclides. In addition to the graphs representing the response of a 3 in. x 3 in. NaI detector in a standard geometrical arrangement, the data are presented in digital form for the preparation of punched-card, perforated tape, or magnetic tape libraries for data analysis. An important addition to the catalog is data for neutron-deficient isotopes. The new edition is prepared in two looseleaf volumes and contains data for almost 300 isotopes. All spectra are normalized to a standard set of gain scales, and a text is presented that describes the fundamentals of gamma-ray spectrometry. This includes a discussion of spectrometer design, electronics, instrumental calibration, and data processing. To facilitate the use of these data, tables of detector efficiency, photopeak efficiency, and other information useful for quantitative data analysis have been included. An extensive index has also been added with separate tables of data listed according to gamma-ray energy, half-life, method of source production, and other specialized categories. Author

N65-11134# Phillips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
SCINTILLATION SPECTROMETRY. GAMMA-RAY SPECTRUM CATALOGUE, VOLUME 2
R. L. Heath Aug. 1964 298 p 2d. ed.
(Contract AT(10-1)-205)
(IDO-16880-2)

N65-11185# Naval Research Lab., Washington, D.C. Nucleonics Div.
ANALYSIS OF ERRORS IN BUBBLE CHAMBER TRACK MEASUREMENTS Interim Report
R. G. Glasser 7 Aug. 1964 21 p
(NRL-6150; AD-605165)

The general procedures of propagation of errors have been applied to derive error estimates for the quantities derived in the geometrical reconstruction of tracks and points in space from overdetermined stereoscopic measurements. Formulas are given that are suitable for use in computer programs such as PACKAG. The sources of error explicitly considered are measurement errors and multiple scattering errors. All computations use a gaussian approximation to the distribution function. Author

N65-11215# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
RESONANCES IN THE $S^{32,33,34}$ (p, γ) $Cl^{33,34,35}$ REACTIONS WITH BOMBARDING ENERGIES IN THE ONE MEV TO TWO MEV RANGE
Anthony Kalil Hyder, Jr. (M.S. Thesis) May 1964 51 p refs
(GSP/Phys/64-6; AD-603601)

A search for resonances in the $S^{32,33,34}$ (p,γ) $Cl^{33,34,35}$ reactions for proton energies in the one- to two-MeV range has been conducted. Natural sulfur targets, in elemental form with a thin gold overlay, with thicknesses about 5 keV for 1.5-MeV protons, and enriched S^{33} and S^{34} targets, in Ag_2S compound form, with thicknesses about 1 to 2 keV for 1.5-MeV protons, were used. Gamma rays were detected at 55° relative to the proton-beam direction. In each of the three yield curves, pulses were counted simultaneously with three scalers biased for selected gamma-ray energies. Approximately thirty S^{34} resonances, in addition to those listed in a review article by Endt and Van der Leun, were found in the energy region studied. The observed resonance widths were less than or equal to 2 keV, except for the $\Gamma \approx 5$ keV, $E_p = 1510$ keV resonance. In the S^{33} yield curve, 12 prominent resonances, with widths less than or equal to 2 keV were observed, in addition to others previously known. Above 1600 keV, evidence for many weak, closely spaced S^{33} resonances was found. In the yield run made with a natural sulfur (95% S^{32}) target, a resonance was found at $E_p = 1754$ keV that could be attributed to S^{32}. The S^{32} resonance at $E_p = 1900$ keV, previously reported by Lonsjo, was not observed. Author

N65-11219# RAND Corp., Santa Monica, Calif.
THE COMPTON CURRENT AND THE ENERGY DEPOSITION RATE FROM GAMMA QUANTA—A MONTE CARLO CALCULATION
R. E. Le Levier Jun. 1964 48 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4151-PR; AD-606028)

The Compton current and the energy deposition rate generated by monoenergetic sources of gamma quanta are calculated for gamma quanta energies of 1, 1.5, 2, 3, and 4 MeV using standard Monte Carlo techniques. Histograms of the current and the energy deposition rate are presented that show the timespread of these quantities due to the multiple scattering of the gamma quanta. It is found that if the secular time variation of the source of the gamma quanta is slow relative to the timespread induced by the multiple scattering, then the Compton current and the energy deposition rate are determined by the total flux of gamma quanta, direct beam plus scattered flux. If the secular time variation of the source is rapid relative to the timespread induced by the multiple scattering, then there are two cases to be considered. For a source that is increasing with time, the Compton current and the energy deposition rate are determined mainly by the flux of the direct beam. For a source that decreases rapidly with time, these quantities are determined mainly by the scattered flux. The properties of the Maienschein prompt gamma-ray spectrum are investigated and it is found that with this spectrum, the main contribution to the Compton current in sea level density air comes from gamma quanta energies of 1.5 MeV at a distance of 500 m from the source. At a distance of 1000 m, the spectrum hardens and the important energies center around 2.5 MeV. Author

N65-11238# Harry Diamond Labs., Washington, D.C.
PHYSICAL BASIS FOR HUND'S RULE, II
N. Karayianis 25 Aug. 1964 14 p refs
(HDL-TR-1247; AD-447173)

A simple model is proposed that is useful for understanding the role played by the C interaction in determining the total orbital angular momentum of an atomic ground state. An example is given, and some possible shortcomings of the model are discussed. Author

N65-11243# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
RESONANCES IN THE INELASTIC CROSS SECTION OF HELIUM

G. J. Schulz and J. W. Philbrick 12 Aug. 1964 9 p refs
(Contract Nonr-2584(00); ARPA Order 125-63; Proj. Defender)
(TR-26; AD-446725)

This paper presents experimental evidence for structure in the inelastic cross section in helium that is interpreted in terms of compound states above the lowest electronically excited state. A study of the inelastically scattered electrons at an angle of 72° shows that structure in the 2^3S cross section exists for electron energies around 21 eV and 22.4 eV. Author

N65-11270# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
GENERAL RESEARCH: IONIZATION BY SERIES LINE ABSORPTION IN ALKALI METAL VAPORS AND ITS APPLICATION TO THE DESIGN OF NARROW-BAND ULTRAVIOLET PHOTOMETERS
R. D. Hudson 12 Dec. 1963 20 p refs
(ATN-64-(9233)-5; AD-427276)

An investigation of the photoionization of sodium vapor from 2400 to 3500 Å has revealed ion peaks at wavelengths that correspond exactly to the principal series lines. This phenomenon and similar phenomena in cesium and rubidium vapors observed by other workers are discussed. Criteria are put forward for the use of this effect in the design of extremely narrow-band ultraviolet photometers (of the order of 0.1 Å) with quantum efficiencies above 10%. Author

N65-11312*# National Aeronautics and Space Administration, Washington, D.C.
CALCULATION OF THE STATISTICAL SUMS FOR DIATOMIC MOLECULES TAKING INTO ACCOUNT THE HIGHLY EXCITED ELECTRON STATES [VYCHISLENIYE STATISTICHESKIKH SUMM DVUKHATOMNYKH MOLEKUL S UCHETOM VYSOKIKH VOZBUZHDENNYKH ELEKTRONNYKH SOSTOYANIY]
R. I. Artym Nov. 1964 18 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 38, no. 7, 1964
(NASA-TT-F-9175) OTS Prices: HC $1.00/MF $0.50

Calculations of the contributions to the statistical sum of the 41 electron states with excitation energies above 90 000 cm^{-1} has been made for N_2 by means of a method proposed earlier. At 20 000° K the contributions calculated in percent of the statistical sums of the ground state are correspondingly 5.1%, 21.7%, and 64.8%. Author

N65-11390# Maryland U., College Park
[EXPERIMENTAL AND THEORETICAL PROGRAM FOR MEASUREMENT OF STARK BROADENING OF LINES FROM LIGHT ELEMENTS; MEASUREMENT OF THE UV RADIATION FROM SHOCK HEATED PLASMAS; AND COLLISIONLESS PLASMA SHOCK WAVE EXPERIMENT] Status Report, Mar. 1–May 30, 1964
Hans R. Griem [1964] 8 p
(Contract Nonr-595(10))
(AD-602219) OTS: $1.00

In the experimental program, the photographic measurement of shifts (the Stark broadening of lines) was inconclusive because only the strongest NII lines could be observed, the response of the sodium–salicylate–aluminum detector for uv radiation was investigated by inserting various wire mesh screens into the evacuated light path and by comparing visible and uv attenuation. The radial-temperature profile and magnetic-field distributions in the collisionless plasma shock-wave experiment were measured. D.E.W.

N65-11474# Air Force Systems Command. Wright-Patterson AFB, Ohio Foreign Technology Div.
NEW SEARCHES FOR HEAVY ISOTOPES OF HYDROGEN
N. A. Vlasov 17 Apr. 1964 7 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 14, no. 6, Jun. 1963 p 593–594
(FTD-MT-63-343; AD-606073)

The possibility of the existence of the H^4 and H^5 isotopes of hydrogen is discussed by reviewing results reported from the synchrotron laboratory in Frascatti, Italy, and from two American laboratories. M.P.G.

N65-11501# Rochester U., N.Y.
A DYNAMICAL MODEL FOR NON-LEPTONIC DECAYS OF HYPERONS
Riazuddin, Fayyazuddin, and A. H. Zimerman 16 Oct. 1964 23 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-59)

A dynamical model based on broken unitary symmetry is developed for nonleptonic decays of hyperons. The contributions to these decays are taken from the primary current-current interaction and from poles due to the baryons, the K-meson, Y_0^* (1405), and the decuplet of baryon resonances (B_{10}^*). The contributions from the baryon and K-meson poles are calculated on the assumption that weak baryon-baryon and K-π transitions transform like divergences of the relevant weak currents, which are members of octets. The contributions from poles due to Y_0^* and the B_{10}^* resonances must be included to explain the p-wave amplitudes. Both s- and p-wave amplitudes then satisfy the triangular relations and fit the experimental values for the signs and magnitudes. The model predicts the correct sign of the $(K_2^0 - K_1^0)$ mass difference. Author

N65-11689# Argonne National Lab., Ill. Reactor Physics Div.
A STUDY OF THE 1/E SLOWING-DOWN NEUTRON SPECTRUM USING 4π-RECOIL PROPORTIONAL COUNTERS
Edgar F. Bennett Sep. 1964 40 p refs
(Contract W-31-109-ENG-38)
(ANL-6897) OTS: $2.00

The response to a 1/E neutron spectrum of a hydrogen-filled proportional counter in the energy region below 100 keV was studied using pulse-shape discrimination to reject gamma-induced background. The observed proton-recoil distributions permitted an evaluation of W (the energy loss per ion pair) for protons in hydrogen below 10 keV. Some problems associated with the use of 4π-recoil proportional counters as neutron spectrometers were considered, including calibration, optimization of neutron-to-gamma ratios, and resolving power. Author

N65-11707# Princeton U., N.J. Elementary Particles Lab.
A MEASUREMENT OF PROTON-PROTON POLARIZATION AND TRIPLE SCATTERING PARAMETERS D, R, A, AND A' AT 430 MEV
Richard F. Roth (Ph.D Thesis) 30 Jul. 1964 98 p refs
(Contract Nonr-1858(06))
(TR-33; AD-605305)

The polarization parameters P, D, R, A, and A' have been measured at 7 scattering angles between 30° and 120° in the center of mass with an incident energy of 430 MeV. A 56% polarized beam was prepared by scattering on an internal beryllium target in a synchrocyclotron. A liquid hydrogen target was used for the p-p scattering, and the outgoing polarization was analyzed with a third scattering in the carbon plates of a spark chamber. The scattering asymmetry, ϵ, was determined by fitting

the data to a distribution $1 + \epsilon \cos \theta$ by the maximum-likelihood method. The analyzing power of the spark chamber as a function of energy was measured in beams of known polarization. The beam polarization before and after the p-p scattering was manipulated with a solenoid and two bending magnets. Author

N65-11718# Rochester U., N.Y.
"TARGET MASS" AND "EFFECTIVE TARGET MASS"
M. F. Kaplon and M. L. Shen 5 Nov. 1964 16 p refs Submitted for Publication
(Contract AT(30-1)-875; Grant AF-AFOSR-439-63)
(URPA-62)

Evidence is presented that questions the validity of attempting to relate the effective target mass to the concept of a virtual pion surrounding the nucleon. Relations between the 4-momentum transfer, the quantity $(E - P \cos\theta)$ of the recoil nucleon and the effective target mass, are derived, showing, in conjunction with experimental data, that the effective target mass of the order of a pion mass occurs accidentally. Author

N65-11903*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
INTENSITY AND INTENSITY RATIO OF PRINCIPAL SINGLET AND TRIPLET LINES OF MOLECULAR HYDROGEN
George M. Prok and Clifford A. Mc Lean Washington, NASA, Dec. 1964 8p refs
(NASA-TN-D-2522) OTS Prices: HC $0.50/MF $0.50

The work reported by Brasefield on the densities of the principal singlet and triplet lines of molecular hydrogen was transformed into intensity units. To accomplish this, a calibration curve for Brasefield's photographic plates was determined with the aid of results reported by Kruithof and Ornstein on two of the same spectral lines. The intensities resulting from the transformation are presented as a function of electron energy for the 19- to 220-eV range. The intensity ratios for some of the singlet and triplet lines are presented as a function of electron energy. Author

N65-11907*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
POLARIZATION OF PROTONS (d,p) REACTIONS AT 21 MEV
Edmund T. Boschitz and John S. Vincent Washington, NASA, Dec. 1964 20 p refs
(NASA-TR-R-218) OTS Prices: HC $1.00/MF $0.50

The proton polarization in deuteron stripping has been measured for the target nuclei beryllium (Be^9), boron (B^{10}), carbon (C^{12}), silicon (Si^{28}), and calcium (Ca^{40}) between 20° and 120°. The results are generally consistent with other polarization measurements at 13.6 and 15.0 MeV, but they differ markedly from polarization data at lower deuteron energies. A comparison of ground and first excited-state polarizations in Be^9 suggests that the total angular momentum j_n for the captured neutron in both states is the same, that is, $j_n = 3/2$. For the C^{12} reaction, a comparison of the proton polarization with the cross-section asymmetry, induced by 22-MeV vector-polarized deuterons, shows a linear relation that is compared with the distorted-wave Born-approximation predictions. The differential cross sections for deuteron stripping from Be^9, C^{12}, and Ca^{40} have also been measured. Author

N65-11920# Oak Ridge National Lab., Tenn. Physics Div.
A STUDY OF HYPERON PRODUCTION BY 430 MeV/c K^--MESONS IN HELIUM
R. B. Muir (Ph.D. Thesis—Tenn. U.) Nov. 1964 87 p refs
(Contract W-7405-ENG-26)
(ORNL-3717)

Following a review of K^--meson interactions with nucleons a bubble-chamber study of the interaction of 430 MeV/c K^--mesons with ^4He nuclei is reported. Two nucleon absorption of the K^--meson comprised 18.8 ±2.4 percent of the interactions and two π-meson production comprised 7.1 ±2.4 percent. These values were obtained assuming that secondary π-meson absorptions were insignificant. The Σ- to Λ-hyperon conversion process was found to account for 47 ±9 percent of all Λ-hyperons. About one-third of all Σ-hyperons underwent conversion. These values were obtained by examining the momentum distribution of π-mesons associated with Λ-hyperon emissions. No evidence was found of strange particle isobar formation, and no hyperfragments were found. D.S.G.

N65-11952# Naval Radiological Defense Lab., San Francisco, Calif.
MASS YIELDS IN THE FAST NEUTRON FISSION OF U^{233}
L. R. Bunney and E. M. Scadden 31 Jul. 1964 14 p refs
(Contract AT(49-2)-1167)
(USNRDL-TR-769; AD-448461)

The cumulative yields of 16 mass chains in the fission of U^{233} by fission-spectrum neutrons were determined by radiochemical methods. The mass chains were mostly in the rare-earth region of the yield curve. In general, the last radioactive member of the mass chain was isolated, and its activity was measured relative to the activity of Mo^{99}. With this ratio, with pertinent data from the thermal neutron fission of U^{235}, and with the absolute yield of mass 99 in the fission-spectrum neutron fission of U^{233}, the chain yield was calculated. The accuracy of the determinations is estimated to be ±15%, except for mass 161 where it is estimated to be ±30%. The mass-yield curve for the fission-spectrum neutron fission of U^{233} was outlined by reflecting the yield values with the assumption that the average number of neutrons emitted per fission was 2.5. Author

N65-12080*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
NUMERICAL CALCULATION OF POTENTIAL-ENERGY CURVES BY RYDBERG-KLEIN-REES METHOD
Frank J. Zeleznik Washington, NASA, Dec. 1964 8 p refs
(NASA-TN-D-2526) OTS Prices: HC $0.50/MF $0.50

A technique is presented for the numerical evaluation of the integrals occurring in the Rydberg–Klein–Rees method of calculating the potential energy curves for the bound states of diatomic molecules. The technique described is based on the fact that singularities in the integrands of f and g can be removed easily by an integration by parts. It does not require the fitting of the integrand near the upper limit, and essentially retains the original integration variable. M.P.G.

N65-12093# California U., Livermore Lawrence Radiation Lab.
VISIT OF THE U.S. CONTROLLED-FUSION RESEARCH TEAM TO THE U.S.S.R., FEBRUARY 9–23, 1964
Chester M. Van Atta [1964] 202 p
(Contract W-7405-ENG-48)
(TID-21189) OTS: $6.00

This paper contains observations of the U.S. team during their visit to five Russian research institutes. A high caliber

of Soviet theoretical work was observed on nuclear fission, with emphasis on the nonlinear theory, i.e., quasi-linear, wave-wave interactions, collisionless shocks, and turbulence. Also noted were studies of drift instabilities of an inhomogeneous plasma, extended to consider the collisional effect, the finite b-effects, and high-frequency modes. G.G.

N65-12250# Defense Research Corp., Santa Barbara, Calif.
NEUTRON DIFFUSION IN THE EARTH'S ATMOSPHERE
J. Ise Aug. 1964 13 p refs
(IMR-157; AD-448445)

The neutron diffusion in a real atmosphere is computed from an approximation, assuming that the scattering cross section is independent of the energy. It is found that the approximation is always below the true value, and by an increasingly large factor as the altitude increases. G.G.

N65-12297# Columbia U., Irvington, N.Y. Nevis Labs.
MUON DEPOLARIZATION IN SOLIDS
Bob Eisenstein (Ph.D. Thesis) May 1964 64 p refs
(Contract Nonr-266(72))
(R-427; CU-230; NEVIS-124; AD-606475)

When polarized positive muons stop in a solid, they may be depolarized prior to their decay. The presence of a magnetic field along the direction of initial polarization will inhibit, or quench, some of this depolarization. Depolarization and quenching were studied in a variety of solids, including semiconductors, at temperatures as low as 4.2° K. No evidence was found that any muon depolarization is associated with the formation of a muonium atom, which is bound for $> 10^{-10}$ sec, even in samples at 4.2° K. For many samples and temperatures, the quenching of the observed depolarization is consistent with a model in which the muon captures and loses electrons repeatedly, forming a succession of briefly bound muonium atoms. In some of the semiconductors at low temperatures, as well as in other samples, a large fraction of the depolarization is quenched by a field of 100 g. This is seen as evidence for another depolarization mechanism. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-10971# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
THE HYPERSONIC PLASMA CONVERTER: II
K. J. Touryan Nov. 1964 46 p refs
(SC-RR-64-979) OTS: $1.00

The various parameters that govern the operation of the hypersonic plasma generator ASP (Aerodynamic Supply of Power) have been experimentally analyzed. The principle of the generator is that the nose cone of a reentry vehicle serves as a cathode or thermionic emitter of electrons that are conducted through the shock ionized stream, increased in kinetic energy by collisions, and collected over the relatively cool vehicle afterbody that acts as an anode. A load connected between the cathode and anode within the vehicle completes the circuit. A final feasibility study has been made, and some possible modifications are outlined. Test runs in an arc jet, with air as the working fluid, at 12 000 Btu/lb have generated 8 A/in.^{2} short-circuit currents and 2.3-volts open-circuit voltage. Under favorable conditions, full-size reentry vehicles in the altitude range of 200 000 to 80 000 ft are expected to yield several kilowatts of power. M.P.G.

N65-10980# Princeton U., N.J. Plasma Physics Lab.
ON "BOHM-DIFFUSION" IN THE Q-1 DEVICE
N. d'Angelo Jul. 1964 14 p refs
(Contract AT(30-1)-1238)
(MATT-291)

Diffusion of highly ionized cesium and potassium plasmas across a magnetic field has been investigated in the Princeton Q-1 device. It was found that if no current is passed along the plasma column, the diffusion proceeds at a rate in general agreement with collisional diffusion theory. However, if a voltage is applied between the end plates, the plasma density decreases continuously with increasing voltage, while the e-folding length of the radial density profile becomes increasingly larger. This note points out that von Göler's theory of recombination at the end plates, previously proposed as the mechanism responsible for the observed density falloff, may also account for the observed flattening of the radial density profiles. M.P.G.

N65-10983# Illinois U., Urbana Coordinated Science Lab.
INITIATION OF ELECTRICAL BREAKDOWN IN ULTRA-HIGH VACUUM
D. Alpert, D. A. Lee, E. M. Lyman, and H. E. Tomaschke Aug. 1964 63 p refs
(Contract DA-28-043-AMC-00073(E))
(R-234; AD-605426)

Existing theories for the initiation of electrical breakdown are reviewed, together with the experimental observations on which they are based. The experiments described have extended the available data on electrical breakdown between broad area electrodes under ultrahigh-vacuum conditions. The results, together with those of several other experimenters, are interpreted on the basis of a single picture that explains and relates the phenomena of predischarge currents and the initiation of breakdown. Based on field emission from sharp submicroscopic points, this picture predicts breakdown when the local electric field at the cathode reaches a critical value. The local field, which for broad area electrodes may be much larger than the average field, is deduced from observations of field emission prior to breakdown. Author

N65-11025# Joint Publications Research Service, Washington, D.C.
ON THE PROBLEM OF COAGULATING FOG DROPLETS WITH ACOUSTICS OSCILLATIONS
N. P. Tverskoy 25 Nov. 1964 22 p refs Transl. into ENGLISH from Tr. G. Geofiz. Observ. (Leningrad), no. 145, 1963 p 36–48
(JPRS-27552; TT-64-51801) OTS: $1.00

Various phenomena developing when a fog is modified by acoustic oscillations are discussed. The mechanism leading to the dissipation of a fog under these conditions is described. Also discussed is the influence of frequencies in different processes leading to drop coagulation. Author

N65-11027# Aerospace Corp., El Segundo, Calif. Labs. Div.
PLASMA WAVES IN A "SPOKE-WHEEL" MAGNETIC FIELD
Richard L. Liboff 10 May 1963 22 p refs
(Contract AF 04(695)-169)
(TDR-169(3153-01)TN-3; BSD-TDR-63-86; AD-405116)

A study of the cold plasma waves that may propagate in a specific type of two-dimensional magnetic field is initiated. The plasma is assumed to be of uniform density and collisionless; a "spoke-wheel" magnetic field is considered that is both anisotropic and inhomogenous (varying as the inverse radius). Perturbation series solutions are obtained for the first Fourier component of the electric field for the four extreme cases—large and small magnetic field and large and small plasma densities. Author

N65-11085# Aerojet-General Nucleonics, San Ramon, Calif. Research Div.
RESEARCH IN HIGH TEMPERATURE PLASMAS FOR SPACE APPLICATIONS. VOLUME I: PHYSICS
John S. Luce Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Oct. 1964 194 p refs
(Contracts AF 33(657)-11183; AF 33(657)-12385)
(AN-1255; APL-TDR-64-124, Vol. I; AD-608379)

Results of research, engineering, and design work conducted during the past year are presented. Theoretical studies show that adiabatic minimum-B geometries are flute stable at high β. Magnetic field requirements to achieve a quadrupole adiabatic minimum-B mirror-cusp system are discussed. Theoretical and experimental investigations of the dissociative and excitative processes in energetic arcs are reported. Data of this high neutral yield and of the yield of excited neutrals from an arc converter are presented, including diagnostic and spectroscopic analyses. System studies include various methods of injecting and trapping excited and nonexcited H^* and H_2^+, and the trapped particle density required for burnout. A preliminary study of momentum and energy exchange in the exhaust beam from a mirror-cusp system is presented. Author

N65-11255# Miami U., Coral Gables, Fla.
RELATIVISTIC PLASMA IN A MAGNETIC FIELD
Behram Kursunoglu [1963] 29 p *In* Plasma Phys. Bull., Vol. 2, 1963
(Contracts AT(40-1)-2761; AF 19(604)-8082)
(AD-298230)

Transverse and longitudinal oscillations of a low-density relativistic plasma in the presence of a constant magnetic field are considered by neglecting the collisions. The most general form of the relativistic dispersion relations for linear plasma oscillations are derived, and the two extreme cases of zero and infinite equilibrium temperatures are discussed. Author

N65-11273# Ohio State U. Research Foundation, Columbus Antenna Lab.
ELECTROMAGNETIC SCATTERING BY GYROTROPIC CYLINDERS WITH AXIAL MAGNETIC FIELDS
W. C. Y. Lee, L. Peters, Jr., and C. H. Walter 15 May 1964 41 p refs *Its* Rept.-1116-48
(Contract AF 19(604)-7270)
(AFCRL-64-717; AD-606095)

The modified geometrical optics method is applied to find the radar cross section of an infinite, gyrotropic, circular cylinder with an axial magnetic field. The results compare favorably with those obtained using the boundary-value solution. The modified geometrical optics method offers the advantage that it may be applied to a general cylindrical cross section without further development. It may also be applied to other orientations of magnetic field, but the computations are much more tedious. Author

N65-11369# Harvard U., Cambridge, Mass. Engineering Sciences Lab.
TEMPERATURE DISTRIBUTION IN A POISEUILLE PLASMA ARC
Hsing Chuang Jul. 1964 44 p refs
(NSF GP-414)
(TR-8)

Temperature distribution in an argon and a helium plasma generated in a wall-stabilized arc was studied. Good agreement between temperatures obtained by different methods of measurement was shown. Author

N65-11411# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
RADIATION FROM A LINE SOURCE IN A GROUND PLANE COVERED BY A WARM PLASMA SLAB—GENERAL RESEARCH
P. R. Caron and G. E. Stewart 31 Jul. 1964 67 p refs
(ATN-64(9230)-3; AD-444117)

The problem of a magnetic line source in a ground plane coated with a warm plasma slab is investigated. Consideration is given to electromagnetic and plasma waves in the slab and to the coupling at the boundaries between these waves and the free-space fields. An integral expression for the radiation field is obtained and is evaluated by the method of steepest descent. The resulting radiation patterns display interesting effects due to electron pressure, and these are discussed with the help of the transmission line analog to the problem. The surface wave poles are located and discussed using this same analog. Author

N65-11423# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
RADIATION FROM A FULLY IONIZED GAS AT THE PLASMA FREQUENCY
E. C. Taylor 15 Oct. 1964 20 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-185; TDR-469(5220-20)-1; AD-451080)

Thermal radiation from a fully ionized gas near the plasma frequency is investigated theoretically with consideration given to boundary effects. The emission spectrum is a relatively complicated function of frequency, temperature, density, and geometry, and the absorption spectrum can be approximated by a simple function of the three parameters representing frequency, collisions, and geometry. The sensitivity of the absorption curve to these parameters is investigated, and the results are used to interpret recently measured infrared radiation from a theta pinch. Author

N65-11462# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y.
DIAGNOSTICS OF PULSED PLASMAS AND ELECTRON BEAM PLASMA INTERACTIONS Final Report, Feb. 1963–Jan. 1964
Robert R. Pepper Wright-Patterson AFB, Ohio, AF Avionics Lab., 27 Apr. 1964 20 p refs
(Contract AF 33(657)-10820)
(PIBMRI-1208-64; AL-TDR-64-65; AD-606514)

A microwave phase bridge or interferometer was constructed and tested for the purpose of measuring high electron densities in pulsed plasmas. The operating frequency was 140 G/sec; phase-reversing Fresnel zone plates were used for focusing the microwave beam; the reference arm could be either a mirror in free space or a calibrated short and hybrid tee between the generator and detector. The initiation and growth, both in time and space, of a pulsed plasma (1 torr) have been studied by observations of intensity and line shape of several spectral lines. Measurement of Stark splitting yielded plots of electric-field intensity and space-charge distribution as functions of axial position and time. A setup was constructed for studying interactions between an electron beam and a plasma. The plasma was produced by electron impact in the beam when the gas pressure was between 10^{-4} and 10^{-2} torr. Author

N65-11490# California Inst. of Tech., Pasadena
EXPERIMENTAL STUDY OF PLASMA WAVE RESONANCES IN A HOT NONUNIFORM PLASMA COLUMN
John C. Nickel May 1964 83 p refs
(Contract Nonr-220(50))
(TR-22; AD-603533)

The relative frequency spectrum w^2/w_p^2 of plasma wave resonances in the positive column of a low pressure mercury discharge tube has been shown to depend upon the parameter r_w^2/λ_D^2 where r_w is the radius of the column, λ_D^2 is the Debye length defined in terms of the average electron density, and w_p^2 is the square of the average plasma frequency. This paper presents observations of both dipole and quadrupole resonance spectra made on several discharge tubes with r_w

ranging from 0.30 to 0.87 cm. For these measurements ω^2/λ_D^2 varies from about 10^2 to 10^5, and the best fit electron temperatures are found to be of the order of 3 eV. The average electron densities are directly measured using a cavity perturbation technique. Author

N65-11520# Princeton U., N.J. Plasma Physics Lab.
PROJECT MATTERHORN Annual Report, 1 Jan.–31 Dec. 1963
17 Apr. 1964 405 p refs
(Contract AT(30-1)-1238)
(MATT-Q-21) OTS: $5.00

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N65-11606# Northwestern Technological Inst., Evanston, Ill. Gas Dynamics Lab.
MICROWAVE DIAGNOSTICS OF ARC HEATED ARGON PLASMA FLOWS
R. C. Warder, Jr. Apr. 1963 212 p refs
(Contract AF 49(638)-879; Grant AF-AFOSR-62-307)
(NU-GDL-B-1-63; AD-602543)

An experimental investigation of the electrical properties of arc-heated plasma flows has been conducted using microwave diagnostic techniques. The basic theory underlying the propagation of electromagnetic waves in isotropic and anisotropic plasmas necessary for the interpretation of the microwave measurements is presented. Phase shift and attenuation measurements at 78 and 85.3 kMc have been made to determine the electron density and electron collision frequency of the plasma flows. The electron densities that were determined experimentally agree quite well for the two operating frequencies. Comparison of the experimental electron densities with theoretical predictions indicates that the plasma flow is not in equilibrium. Author

N65-11610# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING STABILITY OF IONIC LONGITUDINAL OSCILLATIONS OF PLASMA IN MAGNETIC FIELD
V. N. Oraevskiy 15 Jun. 1963 8 p ref Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), v. 5, 1962 p 39–41
(FTD-MT-63-11; AD-602601)

This study pertains to the mechanism of the nonlinear interaction of waves in a rarefied plasma, causing excitation and attenuation of the plasma oscillations. It was shown that the ionic longitudinal oscillations are unstable through the excitation of two transverse waves at definite values of plasma parameters. G.G.

N65-11612# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE INTERACTION OF PLASMOIDS WITH A SPACE PERIODIC MAGNETIC FIELD
A. A. Kalmykov, V. I. Tereshin, S. A. Trubchaninov, and B. G. Safronov 2 Mar. 1964 10 p refs Transl. into ENGLISH from Fiz. Plazmy i Probl. Upravlyayemogo Termoyadernogo Sintez, Ukr. Akad. Nauk (Kiev) p 223–228
(FTD-MT-64-29; AD-602574)

The parametric resonance in an ionic component of plasmoids in a space-periodic magnetic field was investigated. The forward speed of the plasmoid was determined by the time of flight between two electric probes contained in a vacuum chamber, and the dependence of the longitudinal speed on the magnitude of the measured magnetic field was observed. It was found that the transition of the longitudinal energy of the plasmoid into transverse energy of the ions depends on the modulation percentage, the change of width of the resonance curve, etc. Since in a space-periodic magnetic field the delay of particles carries a resonance character, only the ions of definite mass will be delayed, and all the remaining ions will move with initial speed. G.G.

N65-11613# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON ACCELERATION OF PLASMOIDS IN COAXIAL SOURCE
A. M. Kovalev 2 Mar. 1964 13 p refs Transl. into ENGLISH from Fiz. Plazmy i Probl. Upravlyayemogo Termoyadernogo Sintez, Ukr. Akad. Nauk (Kiev) p 231–237
(FTD-MT-64-31; AD-602573)

The electrodynamic methods of acceleration to obtain high-energy plasmoids are analyzed; with emphasis on the acceleration of plasmoids in a coaxial source. It was found that the speed of the plasmoids increases with the increase of the capacity of the source. The magnitude of the plasmoid speed will be determined by the electrical strength of the gap between the electrodes of the coaxial in an acceleration situation during secondary breakdowns of the coaxial source. G.G.

N65-11617# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STABILIZATION OF "UNIVERSAL" UNSTABILITY OF A WEAKLY INHOMOGENEOUS PLASMA WITH RELATIVISTIC ELECTRONS IN A MAGNETIC FIELD
G. M. Zaslavskiy 26 Dec. 1963 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 148, no. 4, 1963 p 803–805
(FTD-MT-63-149; AD-602561)

The instability that occurs in shortwave nonmagnetic disturbances in an inhomogeneous rarefied plasma confined by a magnetic field is described as "universal," i.e., it is not dependent on the configuration of the magnetic field nor on the relationships between temperature gradient and density gradient. A plasma with nonrelativistic ions and relativistic electrons is considered; in this case, the electronic larmor radius is comparable with the ionic radius. It is shown that calculation of its finiteness can be used as a method of stabilizing the plasma relative to universal instability. M.P.G.

N65-11629# Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
HIGH DENSITY PLASMA PHYSICS Final Report, Oct. 1, 1959–Dec. 31, 1963
Sanborn C. Brown 31 Jan. 1964 5 p refs
(Contract AF 19(604)-5992)
(AFCRL-64-68; AD-602548)

This is a list of publications pertaining to the studies of Bremsstrahlung from highly ionized and transient plasmas, the velocity-distribution measurements, magnetoambipolar diffusion, the harmonics of electron–cyclotron emission, and far-infrared studies of high electron-density plasmas. G.G.

N65-11701# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
AN INVESTIGATION OF HIGH ENERGY RADIO PROPAGATION IN THE ATMOSPHERE Final Report
Walter A. Flood, Dennis P. Malone, and Robert E. Kell Aug. 1963 162 p refs
(Contract AF 30(602)-2077)
(CAL-UB-1363-P-5; RADC-TDR-63-410; AD-423494)

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1. R.F. BREAKDOWN IN A LARGE WAVEGUIDE, PART I W. A. Flood 40 p refs (See N65-11702 02-25)
2. INVESTIGATION OF ION REACTION RATES, PART II D. P. Malone 59 p refs (See N65-11703 02-25)
3. MICROWAVE BREAKDOWN THEORY, PART III R. E. Kell 55 p refs (See N65-11704 02-25)

N65-11702# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
R.F. BREAKDOWN IN A LARGE WAVEGUIDE, PART I
Walter A. Flood *In its* An Invest. of High Energy Radio Propagation in the Atmosphere 40 p refs (See N65-11701 02-25)

Measurements at 106 Mc/sec of the voltage breakdown threshold in O_2, N_2, and air over the pressure range 10μ to 1000μ were made. The results for pressure-gap distance products greater than 20-cm-mm Hg are in reasonable agreement with results reported over the range from 1000 to 10 000 Mc/sec. The measurements do not support the mechanism of attachment to O_2 as the threshold limiting process in air or oxygen. The utility of these experimental data in determining the radio-wave breakdown threshold in the atmosphere is limited to altitudes of less than 60 to 70 km. D.E.W.

N65-11703# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
INVESTIGATION OF ION REACTION RATES, PART II
Dennis P. Malone *In its* An Invest. of High Energy Radio Propagation in the Atmosphere 59 p refs (See N65-11701 02-25)

The principle was proved that ion cyclotron resonance in weakly ionized gases can be detected and that the collision cross section pertinent to the reaction can be determined from the resonance line width. Values of the collision cross sections for N_2^+ ions in N_2, Ar^+ ions in Ar, and O_2^+ ions in O_2 are given. Ion cyclotron resonance was used to detect the presence of ions in a weakly ionized gas without seriously changing the energy of the ions. The situation in which the energy gained by the ion between collisions was greater than kT was also investigated. D.E.W.

N65-11704# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
MICROWAVE BREAKDOWN THEORY, PART III
Robert E. Kell *In its* An Invest. of High Energy Radio Propagation in the Atmosphere 55 p refs (See N65-11701 02-25)

The effect of known processes of electron production and loss upon the steady-state electron concentration and upon atmospheric breakdown is discussed. A simplified model is advanced to describe the electron energy distribution at fields approaching the breakdown value. The application of these concepts to the atmospheric-breakdown problem is discussed, with emphasis on the relevance of laboratory-breakdown measurements to prediction of diffusion-free atmospheric breakdown. It is concluded that the experimental values of 30 V/cm-mm applies as a secure upper bound for the high-pressure case ($p >> 2 \times 10^{-10}$), and that the corresponding upper bound for the low-pressure case ($p << 2 \times 10^{-10}$), on theoretical grounds alone, is $12\pi \times 10^{-3}$ volts/cm-Mc/sec. D.E.W.

N65-11825# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
RADIO FREQUENCY PROPAGATION THROUGH AN INHOMOGENEOUS, MAGNETOACTIVE, NONLINEAR PLASMA MEDIUM Physical Sciences Research Papers No. 49
R. J. Papa Sep. 1964 59 p refs
(AFCRL-64-756; AD-607901)

The Boltzmann equation corresponding to an electromagnetic wave propagating in a magnetoactive plasma is solved by making a spherical harmonic expansion of the electron distribution function. When the magnetic field is reduced to zero, the isotropic part of the distribution function reduces to the form first derived by Margenau. The isotropic part of the distribution function depends upon the polarization of the rf wave; that is, the isotropic part of the distribution function depends upon how the electromagnetic energy is divided among the three modes—the right and left circularly polarized modes and the longitudinal mode. A closed form expression for the isotropic part of the distribution function may be obtained for constant-electron mean free path. For moderate field intensities, an expression for the nonlinear plasma conductivity tensor may be derived. Each component of the nonlinear conductivity tensor is a function of the polarization of the rf wave at that point in the medium. Author

N65-11857# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
COMMENTS ON THE SYNTHESIS OF LONGITUDINALLY INHOMOGENEOUS PLASMA-DIELECTRIC MEDIA
Martin C. Blyseth *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964 Vol. V [1964] 15 p refs (See N65-11852 02-07)

The techniques of n-dimensional optimization are combined with certain evaluation procedures to yield a technique for the synthesis of longitudinally inhomogeneous plasma-dielectric media. There are a number of methods for evaluating

the reflection and transmission coefficients of longitudinally inhomogeneous media for which distributions of dielectric constant and conductivity (or of collision frequency and electron density for a plasma) can be specified analytically in terms of the optimization variables and thereby made compatible with the n-dimensional optimization technique. The application for three media is discussed: (1) a homogeneous multilayer using standard multilayer evaluation techniques; (2) an inhomogeneous multilayer composed of linear and quadratic variations using a matrix multiplication evaluation technique; and (3) a continuously defined inhomogeneous structure using iterative techniques. D.S.G.

N65-11872*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
MAGNETIC BREAKDOWN IN A FINITE ONE-DIMENSIONAL MODEL
Gabriel Allen Washington, NASA, Dec. 1964 73 p refs
(NASA-TN-D-2554) OTS Prices: HC $3.00/MF $0.75

Exact solutions have been obtained of the Schrödinger equation for a model approximating an electron in a one-dimensional periodic potential acted on by a transverse uniform magnetic field. In this model the periodic potential is approximated by a finite chain (20 atoms long) of "periodic" square wells, and the parabolic potential due to the magnetic field is approximated by a parabolic square-well potential. Procedures are presented for obtaining solutions for arbitrary combinations of the well depth of the periodic potential V_0, the magnetic field strength H, and the ratio of well dimension (2w) to the atomic dimension (a), 2w/a. Eigenvalues and wave functions were computed for the case 2w = a/2 for several values of V_0 and H. The solutions obtained are valid for arbitrary field strengths, but in order to detect magnetic breakdown effects in such a short chain, very large values had to be used. Author

N65-11885# Geophysics Corp. of America, Bedford, Mass.
STABILITY OF AN IRRADIATED PLASMA SLAB UNDER CRITICAL POWER LOADING
E. T. Florance, R. V. Sillars, and J. I. F. King Griffiss AFB, N.Y., RADC, Sep. 1964 49 p refs
(Contract AF 30(602)-3297)
(RADC-TDR-64-272; AD-607435)

The effects of an upper bound on the ionization frequency for a plasma slab irradiated with intense microwave power are investigated using a Chapman-function model. A quadrature algorithm is developed for the numerical computation of exact steady-state electron-density profiles. The results for both stable and unstable profiles are analyzed in terms of a stability condition involving the deposition rate of microwave power. The dynamics of the electron distribution within the slab is treated approximately by constraining the density profiles to a sinusoidal form. A dynamical interpretation of stability then emerges from the approximate electron gain-loss equation. The stability problem is also formulated graphically by the introduction of a potential-like function. Steady-state characteristic curves for the plasma slab are calculated using sinusoidal density profiles; typical contours of constant net electron gain rate are similarly presented. Author

N65-11955# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
THEORY OF PINCH EFFECT IN ELECTRON-HOLE PLASMAS
James E. Drummond and Betsy Ancker-Johnson May 1964 15 p refs
(DI-82-0356; AD-605925)

An electron-hole plasma initially injected into a semiconductor at current-carrying contacts is compressed by its self-produced magnetic field. Extremely large power densities occur on the axis of such pinched plasmas. This causes rapid heating of the lattice and plasma within the pinch channel. Analog computer studies have been used to follow the thermal ionization on the axis of the pinch, as well as the concentration of plasma ejected from the inner region by pressure unbalance. The concentration of ejected particles rapidly builds up to exceed even that produced directly by the rising temperature on the axis. Accompanying the increase in the number of carriers is a large decrease in the voltage necessary to sustain constant current through the sample. The lower voltage reduces heat production on the axis, which causes a readjustment of temperature and of the number of carriers, producing a slight voltage rise. Author

N65-12017*# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF COLLISION PROBABILITY OF ELECTRONS AND IONS WITH ALKALI METAL ATOMS Semi-annual Report, 22 Apr.–21 Oct. 1964
R. H. Bullis and W. L. Nighan 10 Nov. 1964 63 p refs
(Contract NAS3-4171)
(NASA-CR-54223; UACRL-C-920243-6) OTS Prices: HC $3.00/MF $0.75

This report is a summary of the experimental research investigations conducted to determine the collision probabilities of electrons and cesium ions with cesium atoms. A cesium arc discharge is being used in conjunction with electrostatic and rf conductivity probe techniques to determine the collision probability of electrons with cesium atoms over the energy range from 0.1 to 0.5 eV. Further cesium ion–cesium atom collision probability measurements are being made in the existing modified Ramsauer beam experiment to extend the energy range of these measurements below 0.1 eV. Author

N65-12031# RAND Corp., Santa Monica, Calif.
CERENKOV RADIATION FROM CHARGED PARTICLES IN A PLASMA IN A MAGNETIC FIELD
W. Sollfrey and H. Yura Oct. 1964 36 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4316-ARPA; AD-450561)

The Cerenkov radiation from electrons in a plasma in a magnetic field has been calculated by Kolomenskii, who determined the allowed frequency regions and the energy loss. It is shown here that his results are in error. The allowed frequency regions have a much more complicated dependence on the plasma frequency, gyrofrequency, and electron velocity than he indicates, and he overestimates the energy loss for electrons in the earth's ionosphere by a factor of about 100. The total energy loss from slow electrons by Cerenkov radiation is comparable to their synchrotron loss, but is mainly at lower frequencies. For fast electrons, the Cerenkov loss is much smaller than the synchrotron loss. Author

N65-12085*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THEORETICAL ANALYSIS OF SEVERAL LINEAR STEADY-FLOW PLASMA ACCELERATORS WITH CROSSED ELECTRIC AND MAGNETIC FIELDS
Clarence W. Matthews Washington, NASA, Dec. 1964 53 p refs
(NASA-TR-R-212) OTS Prices: HC $1.50/MF $0.50

The ideal one-dimensional equations that express the motion of an inviscid, compressible, conducting, single-fluid plasma through crossed electric and magnetic fields are written in a nondimensional form. Solutions of these equations are then

presented for conditions wherein the cross-sectional area is held constant or is allowed to vary in such a way that the velocity, pressure, or density is held constant. These conditions are considered for a number of variations of the current density with velocity. Several special cases are also presented in which the velocity, pressure, temperature, or Mach number is held constant in a constant-area channel. For illustrative purposes computed results are presented for most of the solutions. These results are used to show the nature of the various modes of channel operation, and may be used to compare modes and to make a preliminary selection of the mode of operation required to achieve a given purpose. These computations show whether a channel will accelerate or decelerate the flow, whether the flow is regular or forbidden, whether the velocity is limited or unlimited as the channel length becomes infinite, or whether other unexpected peculiarities exist. Author

N65-12097 Colorado U., Boulder
DYNAMIC BEHAVIOR OF A LONG THIN ELECTRON BEAM BEYOND CRITICAL PERVEANCE
J. C. Twombly 30 Dec. 1963 38 p refs
(Contract Nonr-1147(06))
(TR-3; AD-603078)

A digital computer simulation is evolved for studying the dynamics of a vanishingly thin, infinite, planar sheet beam injected with symmetry between two parallel semi-infinite plane conductors joined by a third equipotential plane through which the beam is injected. Derivation of the force equation is given, and the computer program is outlined. Author

N65-12103*# National Aeronautics and Space Administration, Washington, D.C.
SUPERSONIC MOTION OF A BODY IN PLASMA [O SVERKHZVUKOVOM DVIZHENII TELA v PLAZME]
A. V. Gurevich and L. P. Pitayevskiy Nov. 1964 17 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 5, 1964 p 817–824
(NASA-TT-F-9174) OTS Prices: HC $1.00/MF $0.50

Various approximate methods for computing the ion concentration at great distances from a body moving in plasma are compared. A dimensionless equation has been derived that describes the perturbation of plasma behind the body. A similarity law for such motions has been formulated. Author

N65-12126# Stanford U., Calif. Microwave Lab.
THE RESONANCE PROBE—A TOOL FOR IONOSPHERE AND SPACE RESEARCH
F. W. Crawford and R. S. Harp Wright-Patterson AFB, Ohio, ARL, Oct. 1964 36 p refs
(Contract AF 33(616)-8121)
(ARL-64-137; AD-608440)

Experiments on the rf impedance between two probes immersed in a plasma and on the incremental dc characteristics of an rf-modulated probe, have suggested that resonance effects occur at the local electron plasma frequency, ω_p, and can interpreted to obtain a direct measurement of electron density, free from many of the errors to which conventional Langmuir probe techniques are prone. Diagnostic techniques based on these experiments have already been applied in ionospheric research. It is shown here that the two resonance effects are strongly related, but that the resonant frequency occurs below ω_p. The extremely complicated theory that describes the resonance probe behavior accurately can be simplified to yield a model that gives predictions agreeing well with experiment. This model is developed and applied to several different probe geometries of interest in ionospheric and space studies. Author

N65-12127# Stanford U., Calif. Microwave Lab.
CHARACTERISTICS OF THE PLASMA RESONANCE PROBE
R. S. Harp and F. W. Crawford Wright-Patterson AFB, Ohio, ARL, Oct. 1964 46 p refs
(Contract AF 33(616)-8121)
(ARL-64-139; AD-608613)

Detailed experiments have been carried out to confirm the predictions that the resonance frequency lies below the local electron plasma frequency, that it is dependent on probe potential and probe size and, that the resonance should be highly damped when probe dimensions are smaller than a few electronic Debye lengths. If the resonance probe is to be of great practical importance, a simplified theoretical model describing its behavior is desirable. The theory of such a model is presented and compared to experimental results. This paper concludes with a discussion of improved methods of applying the resonance probe. Author

N65-12159# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THEORY OF NON-EQUILIBRIUM IONIZATION IN WET ALKALI METAL VAPORS—CONTINUOUS CHANGING MODEL
John M. Smith Oct. 1964 31 p refs
(Contracts AF 33(657)-8298; AF 49(638)-914)
(R64SD70; AD-608093)

A theory for nonequilibrium ionization in wet-alkali metal vapor is formulated. The medium is considered to consist of electrons, neutral gas atoms, positively charged atomic ions, and charged vapor droplets. The degree of ionization of the gas atoms is assumed to be given by Saha's Law evaluated at the electron temperature, whereas the degree of charging of the vapor droplets is obtained by equating the random electron current in the gas to the thermionic emission current of the vapor droplet at its internal temperature. The electron temperature is determined by equating the Joule heating rate of the electrons to their rate of energy loss due to elastic electron–atom, electron–ion, and electron–droplet collisions, and inelastic electron–droplet collisions. The droplet internal temperature is determined by equating the rate of droplet heating due to electron bombardment to the rate of cooling due to atom and ion bombardment. Author

N65-12160# AVCO-Everett Research Lab., Everett, Mass.
CURRENT SHEET TILT IN A RADIAL MAGNETIC SHOCK TUBE
Rolf B. Johansson Sep. 1964 22 p refs
(Contract AF 49(638)-659)
(RR-189; AD-608147)

This paper describes an experiment carried out in a radial (inverse pinch) shock tube with argon of 50μ to 400μ pressure and hydrogen of 100μ pressure. The current sheet was found to be tilted so that the cathode side lagged the anode side. At the anode the shock has a tilt in the same direction as the current sheet. At the cathode the shock is normal. These phenomena can be correlated by physical models, which assume that the current is predominantly carried by the ions. Author

N65-12261# Raytheon Co., Waltham, Mass. Research Div.
STUDY OF MICROWAVE GENERATION BY MEANS OF ELECTRON BEAM INTERACTION WITH ANISOTROPIC MEDIA Fourth Quarterly Progress Report, 1 Apr.–30 Jun. 1964
S. F. Paik and R. J. Briggs [1964] 44 p refs *Its* Rept.-4
(Contract DA-36-039-AMC-02362(E))
(S-663; AD-447027)

The dispersion diagram of the surface-backward-wave mode on an annular plasma column was measured in the presence of an axial magnetic field. It was shown that the attenuation of the wave increased with the increasing magnetic field. The experimental work on the measurement of the dispersion diagram is outlined, and results of the measurement of the spatial density variation, as well as the effect of the magnetic field on the density of the column, are presented. The theory of resonance absorption due to radial density inhomogeneity is developed as a possible explanation for the observed effect. Author

N65-12266# Comitato Nazionale Per l'Energia Nucleare Frascati (Italy) Laboratorio Gas Ionizzati
STABILITY OF A COLLISIONLESS, NON-UNIFORM PLASMA [STABILITA' DI UN PLASMA NON UNIFORME SENZA COLLISIONI]
B. Bertotti Brussels, EURATOM, 1964 8 p refs In ITALIAN; ENGLISH summary. Presented at the meeting "Alcuni Aspetti della Fisica del Plasma", Milan, 6–7 May 1963
(EUR-535.i) Available from Belgian Am. Bank and Trust Co., N.Y., Account No. 22.186: 25 Belg. Fr.

The transition between two plasma regions where the magnetic field has a different intensity occurs through a current sheath whose thickness is not smaller than the electrons' Larmor radius r. The stability of this system against electrostatic perturbations whose wavelength, proportional to the Debye length, is much smaller than r is discussed. When the propagation vector is directed along the density gradient (say, in the x direction), a sufficient criterion of instability can be stated in the following way: For a given value of the magnetic potential Φ, construct the xx-component of the stress tensor

$$P_{xx}(A, \Phi) = \Sigma m \int d^3 v v_x^2 f,$$

where the summation runs over all the species present. If $\int^2 P_{xx}/\delta\Phi^2$ is negative, Penrose's criterion leads to the conclusion that the plasma is unstable. The above inequality means also that the system is not able to screen an external, static electric field. Author

N65-12280# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
CALCULATION OF THE RADIAL EMISSION COEFFICIENT AND RADIAL TEMPERATURE PROFILES OF A CYLINDRICALLY SYMMETRIC OPTICALLY THICK PLASMA
Thomas F. Jerrick (M.S. Thesis) May 1964 45 p refs
(GSP/Phys/64-7; AD-603600)

An iteration method was developed for obtaining the spectral emission coefficient of a cylindrically symmetric, optically thick plasma as a function of radius from the equation relating the emission coefficient to the observed, edge-on intensity profile of the plasma. The method is valid for a wide range of total absorptivity of the plasma ($0 < \alpha < 0.70$). The method requires representing the experimental data by polynomials, and the solution is also in the form of a polynomial. The spectral absorption coefficient is determined, and the radial temperature profile of the plasma is calculated from Kirchoff's law. A computer program has been written to perform all necessary numerical calculations. The accuracy of the method is limited by the accuracy of the representation of the experimental data. Author

N65-12300# Los Alamos Scientific Lab., N. Mex.
IONIZATION PHENOMENA IN A CESIUM THERMIONIC CONVERTER PLASMA
Daniel Wilkins 28 Aug. 1964 39 p refs
(Contract W-7405-ENG-36)
(LA-3143-MS) OTS: $1.00

Molecular and atomic ion formations in cesium plasmas are compared. It is found that for emitter temperatures greater than 1700° K, the atomic ions are the dominant species. Below 1700° K, there appears to be a narrow range of electron temperatures in which it is possible for the number of molecular ions to be comparable to the atomic ion number. There is also a narrow range of electron temperature in which the atomic ion density may sharply increase by as many as two orders of magnitude. This sharp increase may give rise to the ignited mode of operation noticed in many converters when sweeping from the open-circuit condition to the short-circuit condition. Author

N65-12323# Princeton U., N.J. Plasma Physics Lab.
OBSERVATION OF MICROWAVE RADIATION FROM PLASMA OSCILLATIONS
A. Y. Wong and A. F. Kuckes Aug. 1964 10 p refs
(Contract AT(30-1)-1238)
(MATT-288)

The radiation produced by a highly ionized cesium plasma was measured by radiometer and compared with the theoretically expected radiation temperature, computed with the application of Kirchhoff's law. The absorptivity was calculated by considering the attenuation of an extraordinary wave due to electron–ion collisions. The discrepancy between the experimental and theoretical values was explained by the less-than-unity coupling between plasma and the focusing lens. G.G.

N65-12333# Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France) Centre d'Etudes Nucleaires
THE FIRST CAPEL EXPERIMENT [LA PREMIERE EXPERIENCE CAPEL]
Pierre Hubert Brussels, EURATOM, Jul. 1964 41 p refs In FRENCH; ENGLISH summary
(CEA-2417; EUR-545.F) Available From Belgian Am. Bank and Trust Co., N.Y., Account No. 22.186: 50 Belg. Fr.

Electrostatic periodic perturbations producing a resonance effect with Larmor motion are applied for trapping 1.8-keV electrons in a magnetic mirrors bottle. This method gives temporary trapping lasting more than 20 transits. Switching off the perturbations results in complete trapping of temporarily trapped particles. Lifetime of fast electrons with a pressure of 5.10^{-9}-mm Hg has a value of 12 msec, which seems to result from nonadiabatic effect losses. At the same pressure, ionization of residual gas by fast electrons produces secondary electrons with a lifetime of 1.5 sec, in agreement with evaluations based on the elastic scattering losses assumption. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-11018# Massachusetts Inst. of Tech., Cambridge
FISSION FRAGMENT DAMAGE IN URANIUM DOPED GERMANIUM Annual Technical Report
Robert E. Ogilvie 1 Jul. 1964 21 p refs
(Contract Nonr-1841(84))
(AD-605302) OTS: $1.00

A theoretical model for the spatial distribution of fission fragment damage in bulk crystals of copper and germanium has been developed. Calculations of the energy distribution of primary knock-on atoms and of the range and energy loss of such atoms in the lattice are combined to determine the radial Frenkel defect concentration in a cylindrical fission spike. The radial strain field associated with such a defect concentration

is also calculated and applied to the theory of diffraction contrast of fission tracks in the electron microscope. Several experimental studies of fission damage in bulk materials are discussed in the light of the proposed model. An experimental investigation of fission fragment damage has been made in n-type germanium. Single crystals doped with uranium-235 were grown by the Czochralski method. Segregation effects and dislocation patterns were observed by anomalous X-ray transmission microscopy. Author

N65-11055*# Illinois U., Urbana Coordinated Science Lab.
HIGH MAGNETIC FIELD SUPERCONDUCTORS
C. B. Satterthwaite et al *In its* Progr. Rept. for Mar., Apr., and May 1964 20 Jul. 1964 p 80-88 (See N65-11051 02-23)
OTS Prices: HC $4.00/MF $0.75

Work on magnetization and superconductivity for vanadium and rhenium is discussed. Several small crystals of Nb_3Sn were grown during three runs of the furnace, and, although no detailed analysis of the crystals was carried out, several of the crystals appear to have nearly perfect structure. A typical tunnelling curve between niobium foil and indium film through a layer of niobium oxide is presented, and the dc Josephson effect was observed experimentally. D.E.W.

N65-11056*# Illinois U., Urbana Coordinated Science Lab.
EVAPORATED THIN FILMS
R. N. Peacock et al *In its* Progr. Rept. for Mar., Apr., and May 1964 20 Jul. 1964 p 91-98 refs (See N65-11051 02-23)
OTS Prices: HC $4.00/MF $0.75

Treatments of tin oxide films on glass are described. Measurements of the electrical properties of these films are discussed. Several vanadium films were made and measured, and superconducting properties were determined. D.E.W.

N65-11113# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON ONE SYSTEMATIC ERROR OF MEASUREMENT OF DIELECTRIC CONSTANT BY THE RESONANCE METHOD WITH THE APPLICATION OF A H_{0n} RESONATOR
Ye. B. Zal'tsman and V. Ye. Poyarkova *In its* Invest. in the Area of Radiotech. Meas. 31 Aug. 1964 p 119-125 refs (See N65-11101 02-14)

The results of a theoretical and experimental investigation of the systematic error of measurement of the dielectric constant stipulated by the gap between the dielectric sample and the walls of the resonator are given. The formula of the sought systematic error is derived on the basis of electrodynamic calculation. The calculation is experimentally confirmed. Author

N65-11214# Admiralty Research Lab., Teddington (Gt. Brit.)
CURRENT DISTRIBUTION WITHIN A SUPERCONDUCTING ELLIPTIC CYLINDER
R. A. Pearson Mar. 1964 10 p refs
(ARL/M/R6; ACSIL/64/241; R1/4.103; AD-443627)

The use of Mathieu functions of the first kind to find the current distribution in a superconducting elliptic cylinder of infinite length carrying a steady current parallel to its axis is described. Contour diagrams illustrate the distribution of current in four similar cylinders for different ratios of penetration depth to cylinder dimensions. Author

N65-11240# Michigan U., Ann Arbor Electron Physics Lab.
SOLID-STATE MICROWAVE RESEARCH Interim Scientific Report No. 3, 1 Apr.-1 Jul. 1964
D. C. Hanson, J. E. King, J. E. Rowe, and C. Yeh Aug. 1964 61 p refs
(Contract AF 33(657)-11587)
(Rept.-06031; AD-447667)

The characteristics of phonon interactions in solids are discussed in relation to possible parametric interactions in vanadium doped cadmium sulfide. The energy eigenvalues for cadium sulfide are plotted and discussed. A theory of operation is proposed to explain the "Gunn effect" in bulk semiconductors. Experimental evidence is given for GaAs indicating radiation output in the wavelength region from 300μ to 3000μ. The frequency ω-β diagram for the longitudinal acoustic-wave amplifier is presented, and discussed. The deformation potential acoustic-wave amplifier is analyzed. Thin-film transducers are discussed. Author

N65-11272# Bausch and Lomb, Inc., Rochester, N.Y.
INFRARED COATING STUDIES First Quarter Report 1964
T. P. Martin [1964] 8p refs
(Contract DA-44-009-AMC-124(T))
(AD-446686)

A considerable amount of theoretical work has been done on the problem of enhancing the reststrahlen reflectance of crystals of LiF, MgO, CaF_2, BaF_2, and SrF_2. Very encouraging results have been obtained. Author

N65-11278# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THEORETICAL INVESTIGATION OF THE ELECTRONIC ENERGY BAND STRUCTURE OF CRYSTALS Final Report
Frank Herman Jul. 1964 38 p refs Presented at the Intern. Conf. on the Phys. of Semicond., Paris, 19-24 Jul. 1964 Submitted for Publication
(Contract Nonr-3829(00))
(LMSC-895374; AD-447277)

Shortcomings in earlier attempts at self-consistent band calculations are reviewed. The approach taken in performing nonrelativistic self-consistent band calculations for nonmetallic crystals is then discussed. An essential feature of this approach is a novel mathematical representation for the crystal potential that greatly facilitates the self-consistent iterative process. Preliminary results for diamond, silicon, germanium, and grey tin based on the free-electron exchange model are presented and compared with experiment. These results are the first that actually provide a serious basis for judging the adequacy of this exchange model in applications to valence crystals. Author

N65-11293# Harry Diamond Labs., Washington, D.C.
MEASUREMENT OF NARROW MAGNETIC RESONANCE LINEWIDTHS
Joseph Nemarich 10 Aug. 1964 26 p refs
(HDL-TR-1246; AD-603900)

A discussion is given of the origin of various errors that may occur in the measurement by cavity perturbation techniques of narrow magnetic resonance linewidths. It is shown that the absorption by a spherical magnetic sample in a microwave cavity varies as $\sin^2\theta$, where θ is the angle between the static and microwave magnetic fields. A method of choosing the optimum cavity parameters for minimizing measurement error is presented, and a proof is given of a tuning technique that has been used to compensate for dispersion of the cavity resonance during a measurement. A detailed description is presented of a magnetic resonance spectrometer that has been used for the accurate measurement of magnetic resonance absorptions with widely varying intensities and very narrow linewidths. Author

N65-11339# Kansas State U., Manhattan
THE CRYSTALLOGRAPHY OF SOLID NITROGEN OXIDES SODIUM HYPONITRITE—POTASSIUM NITRITE Final Report

R. Dean Dragsdorf, Shih Chi Chang, and Ralph L. Hollis
3 Aug. 1964 101 p refs
(Grant AF-AFOSR-61-24)
(AFOSR-64-1469; AD-604476)

This is a study of the crystal structure of sodium hyponitrite and potassium nitrite by the X-ray refraction method. Three forms of sodium hyponitrite were obtained—the anhydrous, octa, and penthydrate forms. The power pattern for the anhydrous form was found to be identical with former results. The octahydrate crystals grew from aqueous solutions, but underwent a crystallographic transformation after 2 days. From the pentahydrate crystals formed from this transition, rotation and Weissenberg photographs of the zero, first, and second levels were obtained, and the intensities of the reflections were measured by the visual comparison method, corrected for Lp and temperature factors, and rendered into an absolute intensity scale. The crystal structure of potassium nitrite was redetermined, and the cell dimensions were refined by improving the experimental techniques and by employing the method of the least squares to minimize the error. G.G.

N65-11361# Nottingham U. (Gt. Brit.)
HIGH-RESOLUTION NUCLEAR MAGNETIC RESONANCE IN SOLIDS Annual Technical Report, 1 Aug. 1963–31 Jul. 1964
E. R. Andrew [1964] 23 p refs
(Contract DA-91-591-EUC-3077)
(AD-448503)

By the rapid rotation about an axis inclined at an angle of 54° 44′ to the applied field, the high-resolution nuclear-magnetic-resonance spectra for protons or fluorine nuclei are analyzed. Dipolar broadening has been removed from the ^{19}F nmr spectrum of polytetrafluoroethylene with a rotation rate of 2.8 kc/sec, and the recorded spectra demonstrated a spectral narrowing of the sidebands on either side at multiples of the rotation rate. Improvements in the resolutions were obtained by the use of a new, large, permanent magnet with a set of Golay correcting coils. The second moment of the two ^{31}P nmr spectral lines from phosphorus pentachloride was analyzed. The observed lines were found to be some 10 times narrower than expected for a rigid array of nuclear dipoles, and were assumed to be due to the reorientation of the ionic groups, or to the rapid chlorine spin-lattice relaxation. An alternative mechanism, through modulation of the scalar spin coupling of the phosphorus and chlorine nuclei, is investigated. G.G.

N65-11387# Lincoln Lab., Mass. Inst. of Tech., Lexington
SOLID STATE RESEARCH
1 Sep. 1964 94 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-351; AD-606126)

The following topics are presented: "Solid State Device Research"—diodes of PbTe, the interface-alloy junctions between InAs and GaSb, the vapor growth of $(Ga_xIn_{1-x})As$ single crystals, and n-GaAs at high electric fields; "Laser Research"—the Raman laser program, the optical maser properties of CeF_3, the laser-created gaseous breakdown of air and argon, a pulsed-laser dosimeter, and a gas-laser program; "Materials Research"—the optical measurement of an rf generator output, the analysis of crystal growth from vapor, the electrical properties of transition metal oxides, the transformation heat of Ag_2Se, the rate of cubic-to-hexagonal transformation in $PrO_{1.5}$ and the rate of transformation in $InSb_{II}$-Sn alloys, the pressure dependence of resistance of $Cd_xHg_{1-x}Te$, the partial pressures for CdTe(c), and wet chemical analysis of MnO and CoO; "Band Structure and Spectroscopy of Solids"—investigated are HgTe, antimony, germanium, Mg_2Ge, and the symmetry theory of the Seebeck coefficient; and "Magnetism and Resonance"—theory and experiment. G.G.

N65-11397*# Stanford U., Calif.
CORRELATION OF THE ORBACH RELAXATION COEFFICIENT WITH OPTICAL LINEWIDTHS: $LaF_3:Er^{3+}$
W. M. Yen, W. C. Scott, and P. L. Scott [1964] 17 p refs
(Grant NsG-331)
(NASA-CR-59553) OTS Prices: HC $1.00/MF $0.50

We have measured the lifetime of the first excited state of trivalent erbium in lanthanum fluoride, and find, for 0.05% erbium concentration, an inverse lifetime $W = 7.0 \pm 0.9 \times 10^{10}$ sec^{-1}. For this salt, this value is observed to be equal to the Orbach coefficient occurring in the spin-lattice relaxation of the ground-state doublet, recently measured by M. Schulz using electron-spin resonance techniques. The equality of the inverse lifetime and the Orbach coefficient is in agreement with existing theory. We have also observed concentration-dependent satellite structure in the ground state of trivalent erbium in lanthanum fluoride, which we tentatively attribute to exchange-coupled pairs. We have also observed concentration-dependent broadening in the optical transitions studied. This may be evidence of energy transfer between impurity ions. Author

N65-11416# Princeton U., N.J. Solid State Electronics Lab.
ELECTRONIC PROPERTIES OF ORGANIC SEMICONDUCTORS First Quarterly Technical Report
George Warfield [1964] 3 p refs
(Contract DA-31-124-ARO-D-191; ARPA Order 462)
(AROD-4742-1; AD-450854)

The problem of mobility in narrowband semiconductors is being studied both experimentally and theoretically. A calculation of the band structure and transport properties of phthalocyanine was started. Preliminary calculations indicate that phthalocyanine may have four electron bands participating in the transport process. P.V.E.

N65-11488# Hughes Research Labs., Malibu, Calif. Special Electron Tubes Section
STUDY OF BOMBARDMENT-INDUCED CONDUCTIVITY MATERIALS Final Report, 15 Jul. 1960–14 Jan. 1962
Norman H. Lehrer Wright-Patterson AFB, Ohio. AF Avionics Lab., Oct. 1963 145 p refs
(Contracts AF 33(657)-7789; AF 33(616)-7563)
(ASD-TDR-63-715; AD-421054)

The objective of this work was a phenomenological study of materials that exhibit electron bombardment-induced conductivity (BIC), as well as sustained electron bombardment-induced conductivity (SEBIC) for application to novel display devices. These devices are a direct-view storage tube with high resolution, selective erasure, and the ability to display stored and nonstored information simultaneously, and (2) a high-resolution storage tube containing no meshes. The operation of the direct-view storage tube is reviewed and criteria are established for advantageous use of a BIC dielectric in direct-view storage tubes. The meshless storage tube operation is analyzed, and the required SEBIC material characteristics are established. The theory of bombardment-induced conductivity is defined and related to the materials requirements. Author

N65-11563# Merck Sharp and Dohme Research Labs., Rahway, N.J.
STRUCTURAL INVESTIGATIONS IN THERMOELECTRIC MATERIALS Summary Report, Oct. 1, 1962–Sep. 30, 1963
P. I. Pollak, J. B. Conn, E. J. Sheehan, and C. J. Barclay [1963] 33 p
(Contract NObs-88112)
(AD-606067)

Attention has been directed to the properties of tetrahedrally bonded semiconductors generally, and to those possessing superlattices particularly, with especial reference to the effect of such superlattices on the phonon contribution to thermal conductivity. Two lattice types have been dealt with—those based on zinc blende or wurtzite, and those based on sulvanite (Cu_3VS_4). Some compounds that were prepared

turned out to belong to neither of these classifications, and a great many possible compositions proved not to be compounds at all. These negative results are included for completeness. Author

N65-11632*# California U., Berkeley Space Sciences Lab.
DYNAMIC BEHAVIOR OF POROUS ELECTRODE SYSTEMS Semiannual Status Report, 1 Mar.–31 Aug. 1964
C. W. Tobias 27 Oct. 1964 5 p refs *Its* Ser. No. 5, Issue No. 62
(Grant NsG 150-61)
(NASA-CR-59586) OTS Prices: HC $1.00/MF $0.50

Measurements of current distribution in microfissure electrodes and preliminary experiments for determination of the effect of structure changes on current distribution in sintered, porous, metal electrodes were undertaken. The influence of electrode reaction kinetics on the effective overpotential of flooded porous electrodes was investigated by an extensive computational program. P.V.E.

N65-11634*# General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
DEVELOPMENT OF LOW TEMPERATURE DIELECTRIC COATINGS FOR ELECTRICAL CONDUCTORS Thirteenth Quarterly Report
K. N. Mathes 15 Oct. 1964 36 p refs
(Contract NAS8-2442)
(NASA-CR-59584) OTS Prices: HC $2.00/MF $0.50

This study discusses the factors that are most likely to influence the performance of connectors and terminations at cryogenic temperatures. The following topics are presented: "Dielectric Loss at Low Temperatures—Ice, H-Film, and FEP"; "Dielectric Loss in Cryogenic Liquids"; "Cryogenic Connectors"; and "Connector Design." G.G.

N65-11640# Merck Sharp and Dohme Research Labs., Rahway, N.J.
STRUCTURAL INVESTIGATIONS IN THERMOELECTRIC MATERIALS Quarterly Report, 1 Apr.–30 Jun. 1963
P. I. Pollak, J. B. Conn, E. J. Sheehan, and C. J. Barclay [1963] 20 p
(Contract NObs-88112)
(OR-3; AD-606070)

Temperature curves of resistivity and Seebeck coefficient for the defect quarternary $Cu_{12}Cd_6Sn_6Se_{23}$ show an abrupt increase in both parameters in the range 125° to 175° C, followed by a return to substantially room-temperature values with temperature increase above 175° C. It is postulated that this anomaly is caused by the emptying of electron traps. Compositional variation of parameters for the system $Cu_{12}Cd_{6+x}Sn_{6-x}Se_{23}$ has been completely surveyed, and the only pronounced effect noted was a strong doping by excess cadmium. The composition of $Cu_{12}Zn_6Sn_6Se_{23}$ has been shown to be a random solid solution of ZnSe in Cu_2SnSe_3. Attempts to locate other ordered phases based on the quarternary Cu_2ABX_4 were successful only in the case of $Cu_2MnSnSe_{4-x}$. An examination of the properties of ternaries having the structure of sulvanite (Cu_3VS_4) has been initiated, and Cu_3VSe_4 and Cu_3VTe_4 have been prepared. The latter composition consisted of two solid solutions. It is indicated that no transition metals other than those in group Vb can form sulvanites, and that silver cannot replace copper. M.P.G.

N65-11643# Maryland U., College Park, Md.
SUPERCONDUCTIVITY IN A STRONG SPIN EXCHANGE FIELD
Peter Fulde and Richard A. Ferrell (Ph.D. Thesis) Dec. 1963 52 p refs
(TR-344; AD-602536)

A strong exchange field, such as produced by ferromagnetically aligned impurities in a metal, will tend to polarize the conduction electron spins. If the metal is a superconductor, this will happen only if the spin-exchange field is sufficiently strong compared to the energy gap. When the field is strong enough to break many electron pairs, the self-consistent gap equation is modified and a new type of depaired superconducting ground state occurs. In the idealization of a spatially uniform exchange field with no scattering, it is found that the depaired state has a spatially dependent complex Gorkov field. The presence of the normal electrons from the broken pairs reduces the total current to zero, gives the depaired state some spin polarization, and results in almost normal Sommerfeld specific heat and single-electron tunneling characteristics. Author

N65-11649# Merck Sharp and Dohme Research Labs., Rahway, N.J.
STRUCTURAL INVESTIGATIONS IN THERMOELECTRIC MATERIALS Quarterly Report, 1 Jul.–30 Sep. 1963
P. I. Pollak, J. B. Conn, E. J. Sheehan, and C. J. Barclay [1963] 10 p
(Contract NObs-88112)
(QP-4; AD-606068)

The sulvanite group of compounds was studied. Uncontrolled freezing of compositional melts $Cu_3(V,Nb,Ta)(Se,Te)_4$ seldom yields a pure phase. The case of Cu_3VTe_4 was dealt with in detail as it is typical, and the rather low melting point makes it convenient to handle. None of the sulvanites thus far examined melts congruently; Cu_3VTe_4 displays a stable and unstable freezing behavior that it follows unpredictably from the unseeded liquid. The unstable branch leads to a solid containing considerable amounts of copper tellurides, notably rickardite (Cu_4Te_3). Such solid reverts to pure Cu_3VTe_4 upon annealing. The solid cannot be zone refined if the unstable freezing course occurs, as the capsule invariably shatters. The presence of pure seed phase allows successful zoning to be done. Author

N65-11670# Eastman Kodak Co., Rochester, N.Y. Apparatus and Optical Div.
LASER MATERIAL STUDY Semiannual Technical Report, 1 Jan.–30 Jun. 1964
P. B. Mauer [1964] 11 p refs
(Contract Nonr-3834(00); Proj. Defender)
(AD-604443)

A performance study was made of two types of laser material, matched quite closely in all characteristics except their fluorescence lifetime. Data were recorded to indicate conversion efficiency as a function of input power and the reflectivity of the output mirror. In addition, an estimate of beam divergence was made by comparing images recorded on carbon paper or on developed, unexposed, Polaroid print paper. Conclusions were drawn from these data as to the role of fluorescence lifetime and its related quantum efficiency to the practical performance of a laser material. Author

N65-11680# Harvard U., Cambridge, Mass. Cruft Lab.
SEMI-ANNUAL PROGRESS REPORT NO. 66, 1 JAN.–1 JUL. 1963
J. A. Pierce et al 10 Oct. 1963 179 p refs
(Contracts Nonr-1866(07); Nonr-1866(16); Nonr-1866(28); AF 19(604)-4118; AF 19(604)-5487 et al)
(SAPR-66; AD-445115)

The following topics are discussed: "Very Low Frequency Propagation"; "Electron and Solid State Physics"; "Automatic Control"; "Communications and Networks"; "Microwave Applications of Ferromagnetic and Ferroelectric Materials"; and "Electromagnetic Radiation." G.G.

N65-11687# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
ELECTRONICS RESEARCH PROGRAM: RESEARCH AND EXPERIMENTATION IN OPTICAL PHYSICS Semi-annual Technical Report, 1 Jul.–31 Dec. 1962
P. Kisliuk 1 Apr. 1963 24 p refs
(Contract AF 04(695)-169)
(TDR-169(3250-24)TN-1; SSD-TDR-63-59; AD-403372)

Temperature dependence of the absorption strength of the N_1 and N_2 lines of concentrated ruby, attributed to exchange coupled pairs of Cr^{+3} ions, was studied. On this basis, tentative assignments were made for sign and magnitude of exchange coupling (assumed to be isotropic) and for total spin in the lower state of transition. Other observed lines can then be assigned to transitions between the same upper level and lower levels of different total spin; this agrees with the interval rule and is consistent with the temperature dependence of the lines. Erbium-doped lanthanum trifluoride is discussed briefly. Experiments on mechanical Q-switching and on thermoluminescent crystals are noted briefly. Author

N65-11712# General Electric Co., Schenectady, N.Y. Research Lab.
THERMIONIC EMISSION OF THERMIONIC CONVERTER COLLECTOR MATERIALS IN Cs VAPOR
J. M. Houston and P. K. Dederick *In its* Thermionic Converter Res. Studies Oct. 1964 p 45–81 refs (See N65-11708 02-03)

The thermionic emission, and thus the effective work function, of a number of metals that are, or could be, used in Cs thermionic converters were measured by using the plasma anode technique. The metals studied were W, Ta, Mo, Ni, Cu, No. 304 stainless steel, and Nichrome. In the plasma anode technique, a small loop of wire is immersed in the plasma of a conventional Cs-vapor gas-discharge tube and is run a few volts negative with respect to plasma potential. The small ion current arriving at the loop allows a much larger electron current to leave the loop without encountering electron space charge. A pure alumina insulator is used to shield all except the tip of the emitting loop so as to expose only a small area having a uniform temperature. All the measurements reported were made at one Cs pressure, corresponding to a bath temperature of 414° K. D.S.G.

N65-11713# General Electric Co., Schenectady, N.Y. Research Lab.
UNIFORM WORK FUNCTION SURFACES
H. F. Webster *In its* Thermionic Converter Res. Studies Oct. 1964 p 87–102 refs (See N65-11708 02-03)

Requirements for work-function uniformity and the means of producing uniform work-function surfaces were studied. Experimental measurements of work function and metallographic examinations were performed on the same surface in an effort to correlate electrical properties with surface structure. Two methods, etching and annealing, of producing a metal surface of controlled crystal structure were investigated. The latter was more successful because the structure produced was stable upon further heating. A cause of work-function inhomogeneity of single-crystal surfaces was found to be deviations from flatness of their surfaces. D.S.G.

N65-11767# North Carolina State Coll., Raleigh
GROWTH AND DEFORMATION MECHANISMS IN SINGLE CRYSTAL SPINEL Final Report, Aug. 1962–Jun. 1964
Hayne Palmour, III, R. Douglas McBrayer, David E. Witter, and W. Wurth Kriegel Wright-Patterson, AFB, Ohio, AF Mater. Lab., Sep. 1964 45 p refs
(Contract AF 33(616)-7820)
(ML-TDR-64-284; AD-607778)

This report of a program of research on growth and deformation processes in spinel includes a description of an rf plasma growth facility and its operation. The main conclusion from the growth experiments is that the instability of spinel at its melting point precludes the growth of large stoichiometric single crystals by direct fusion. Alternative techniques are discussed. The effect of heat treatment on the microindentation behavior and room temperature compressive strength of alumina-rich spinel single crystals is discussed. Some high-temperature strength data on alumina-rich spinel are included. Author

N65-11796# Sylvania Electric Products, Inc., Woburn, Mass. Semiconductor Div.
DEVELOPMENT OF EPITAXIAL TECHNOLOGY FOR MICROELECTRONICS AND LARGE AREA DEVICE APPLICATION Quarterly Report, 1 May–31 Jul. 1964
P. Wang and J. Porter 1 Jun. 1961 59 p ref
(Contract NObsr-85431)
(QR-9; AD-447086)

Continued study of oxide-masked selective epitaxial growth resulted in a ± 20% variation in thickness in windows of uniform size and shape. The X-ray techniques used to study epitaxial growth resulted in indications of structural perfection that can be correlated with good integrated circuit performance. Variables were studied, and results were analyzed for the rotating susceptor furnace. Epitaxial material was used to fabricate high-quality devices such as high-voltage, large-area diode junctions, integrated circuits with pnp and npn transistors on the same chip and pnpn matrix structures. Dielectric barrier isolation techniques are being investigated. Growth of silicon on several insulating substrates was studied, and results and theory are discussed. Author

N65-11887# Minneapolis-Honeywell Regulator Co., Boston, Mass. Aeronautical Div.
DEVELOPMENT OF SELF-REPAIR PROCEDURES Final Report, Mar. 1963–Mar. 1964
Griffiss AFB, N.Y., RADC, Sep. 1964 87 p refs
(Contract AF 30(602)-3027)
(RADC-TDR-64-183; AD-608140)

The automatic in-place repair of conductors, resistors, and inductors by the application of special-purpose whisker-growing and postcoating alloys was investigated. Alloy compositions and processing and application techniques were optimized for maximizing repair rates. Problems of practical application to operational systems were identified and evaluated. It was concluded that whereas the techniques investigated have only limited potential feasibility for general practical application, feasibility may exist for specialized applications. The repair of faulty semiconductor devices (diodes) by in-place remelting and rate growing, using passive thermal gradients, was investigated, and was found to be unfeasible for practical application. A literature search on capacitors revealed extensive prior work on the development of capacitors with the inherent capability for self-repair of certain types of failures. Author

N65-11983# HP Associates, Palo Alto, Calif.
ADVANCED FUNCTIONAL ELECTRONIC BLOCK DEVELOPMENT Interim Engineering Report, 1 Jun.–31 Aug. 1963
J. Ajello et al [1963] 97 p refs
(Contract AF 33(657)-9772)
(IER-4; AD-424420)

The continued effort on device technology and physics of electroluminescent GaAs and BP is described. Work on fabrication of el diodes was concerned with the perfection of the GaAs starting material, the transparency of the GaAs windows, and junction technology of BP diodes. Information on fabrication reproducibility of npn silicon phototransistors was obtained. The exploratory work on shifting the photoresponse of photoconductors to match the spectral emissivity of GaAs el diodes

has continued. Material synthesis and crystal growth effort is described; this includes GaAs epitaxial growth by vapor transport using iodine, as well as a combination of $AsCl_3$ and H_2. A thermochemical study of GaAs transport has been undertaken. Single crystal growth of BP was investigated by growth from nickel melt, as well as by vapor transport. Author

N65-11987# Battelle Memorial Inst., Geneva (Switzerland) International Div.
INVESTIGATION OF ABSORPTION AND RE-EMISSION OF OXIDE CRYSTALS CONTAINING DISSIMILAR FOREIGN IONS
W. Schneider 20 Aug. 1964 43 p
(Contract AF 61(052)-696)
(AFCRL-64-797; AD-606837)

Absorption spectra, as well as activation and fluorescence spectra, of corundum single crystals doped with chromium alone, vanadium alone, and chromium plus vanadium, are presented. The fluorescence of benitoite at room temperature and at −190° C has been measured, and the results are discussed. Author

N65-11994# Stanford Research Inst., Menlo Park, Calif.
THE INVESTIGATION OF THE EFFECT OF AN ISOSTRUCTURAL BOUNDARY ON THE PLASTIC FLOW CHARACTERISTICS OF POLYCRYSTALLINE IONIC SOLIDS Progress Report, Oct. 16, 1963–Oct. 15, 1964
A. E. Gorum 15 Oct. 1964 5 p
(Contract Nonr-3988(00))
(PR-2; AD-450409)

The research was concerned mainly with techniques for preparing two-phase bodies, using spherical particles. The use of spherical particles eliminated the grain-growth problem, and other problems encountered in preparing the proper structure were alleviated by using the finer spherical particles. D.E.W.

N65-12003# General Electric Co., Schenectady, N.Y. Research Lab.
ELECTRICAL CONDUCTANCE IN ORGANIC SOLIDS Third Quarterly Progress Report, 1 Jul.–30 Sep. 1964
Charles M. Huggins and Oliver H. Le Blanc, Jr. [1964] 10 p
(Contract DA-31-124-ARO(D)-175; ARPA Order 462)
(AROD-4642-2; AD-451247)

An electron gun system has been constructed that is capable of delivering microsecond pulses of high-energy (>30 keV) electrons to the surface of a polarized crystal. In preliminary studies using single-crystal anthracene at room temperature, copious numbers of electron-hole pairs are created by ionization for each incident high-energy electron. Transit-time measurements in the polarized crystal of the resulting current transients have yielded values for electron and hole mobilities in agreement with previous data from photocurrent studies. A theoretical model has been developed for interpreting the unusual electrical and magnetic properties of the ion-radical salts of tetracyanoquinodimethan (TCNQ). The model involves the application of the Heitler–London treatment of conductivity to these solids. Author

N65-12004# General Electric Co., Schenectady, N.Y. Research Lab.
CEL STORAGE STUDIES Final Technical Report, 28 May 1963–28 May 1964
D. A. Cusano Aug. 1964 24 p refs
(Contract DA-44-009-AMC-201(T))
(AD-447112)

This report summarizes the results of a research study program directed to increasing understanding of thin-film phosphors and cathodoelectroluminescent (CEL) screens of current interest. Epitaxial single-crystal films of zinc sulfide were grown by vapor reaction on CdS and GaAs single-crystal substrates. These and highly oriented microcrystalline films on amorphous substrates were examined in detail. Local nucleation characteristics seem to dominate the epitaxy. Luminescence of the film and the substrate crystal near the interface are markedly dependent on the alignment of major axes. Author

N65-12009# Oslo U., Blindern (Norway) Chemical Inst.
X-RAY AND MAGNETIC STUDY OF THE VANADIUM SULFIDE PHASES V_5S_4 AND VS_{1+x}
F. Gronvold, H. Haraldsen, B. Pedersen, and T. Tufte 14 Feb. 1962 78 p refs
(Contract AF 61(052)-178)
(ARL-62-427, Pt. 1; AD-286671)

The phases V_5S_4 and VS_{1+x} were found. The V_5S_4 is tetragonal. Its unit cell dimensions, space group, and atomic positions are given. The VS_{1+x} ($0<x<0.55$) has a variety of structures of NiAs type with vacant metal sites. For sulfur contents above $VS_{1.125}$ the vacancies become distributed over every other layer in the ab-plane. The monoclinic structure of $VS_{1.35}$ is described in detail. Magnetic susceptibility measurements of selected samples are reported. Author

N65-12035# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SOME NONLINEAR EFFECTS IN FERROELECTRICS
I. V. Lyagin and Ya. I. Geyvashovich 9 Sep. 1964 12 p refs Transl. into ENGLISH from Uch. Zap. Smolenskogo Gos. Ped. Inst. (Smolensk), v. 10, 1962 p 94–102
(FTD-TT-64-453/1; AD-607880)

This study investigates the dependence of the components of the tensor of dielectric receptivity on the intensity of the outer electric field in the range of small fields, within the framework of the thermodynamic theory of the monocrystal. The linear dependence of the polarization on the field is considered, in order to get the dependence of the receptivity. It was found that formation of the induced additions to the components of the initial receptivity and also new diagonal components, which were not present in the computation of the linear approximations, occurred in the ferroelectric phases. Their apperance was found to be connected with the distortion of the symmetry of the crystal under the influence of the field. G.G.

N65-12054# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
DOMAIN WALL MOTION IN THIN NI-FE FILMS
Simon Middelhoek 31 Aug. 1964 11 p Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), no. 4, 1962 p 191–193
(RSIC-256; AD-606046)

The motion of domain walls in thin Ni-Fe films is described. The films are in a continuous field in the light direction with a superimposed alternating field in the hard direction. The experiments show that Bloch–Néel–Bloch wall transitions in films thicker than 900 Å and Bloch line displacements in films thinner than 900 Å are associated with the motion. Author

N65-12066# Tyco, Inc., Waltham, Mass.
ELECTROCHEMISTRY OF FUEL CELL ELECTRODES. THE ELECTRICAL DOUBLE LAYER ON INDIUM AMALGAMS IN O.IM $HC10_4$ AT 25° C
James N. Butler, Mary L. Meehan, and A. C. Makrides Sep. 1964 46 p refs
(Contract Nonr-3765(00); ARPA Order 302-62)
(TM-15; AD-448933)

The double-layer capacity of indium amalgams was measured at 25° C in 0.1 M $HClO_4$ using a dropping electrode. Fourteen amalgams ranging in composition from 0.001 mole % to 64.4 mole % In were studied. At concentrations of indium below 0.001%, the capacity is identical to pure mercury; at higher concentrations, a pseudocapacity due to the dissolution of indium is observed at potentials more positive than the $In\text{-}In^{+3}$ equilibrium potential. As the concentration of indium varies from 1% to 70%, the zero-charge potential shifts 0.4 V more negative, and the capacity-potential curve shows a corresponding shift. The capacity-surface charge curve shows the same hump near the zero-charge point in concentrated indium amalgams as in pure mercury. At a surface charge of -10μ coul/cm^2, the capacity varied from 15μf/cm^2 for mercury to 20μf/cm^2 for 64% indium amalgam. At a surface charge of $+10\mu$ coul/cm^2, the capacity of a 64% indium amalgam was approximately twice that of mercury. The contribution to the capacity from the diffuse double layer was calculated using the Gouy–Chapman theory. The influence of the diffuse double layer is much greater for concentrated amalgams than for mercury. Previous data for hydrogen overvoltage on indium amalgams were used together with the capacity measurements to analyze the effect of the diffuse double layer on the hydrogen discharge reaction. Author

N65-12070# Hughes Research Labs., Malibu, Calif.
RESEARCH INVESTIGATION OF p-i-n ELECTRON JUNCTION DETECTORS Interim Engineering Report, 11 Aug.–11 Nov. 1963
Nov. 1963 14 p
(Contract NObsr-89169)
(IER-3; AD-424169)

Thick sources containing both thallium-204 and phosphorus-32 have been utilized in carefully specified geometries for the purpose of comparing the response of silicon lithium-drifted p-i-n junction detectors to β-ray sources with extrapolation chamber measurements of the surface absorbed dose rate. Dose-rate measurements have been made with both spectra using sources having areas of 1.04 cm^2, 10.0 cm^2, and 100 cm^2. Open-circuit voltage measurements have been completed for all these source configurations using a number of thin-window p-i-n junction detectors. Comparison of results for the two β-ray spectra shows a slight energy dependence in the correlation between the induced junction potential of the detectors and the surface absorbed dose rate, the softer thallium-204 spectrum giving a closer correlation than that of the phosphorus-32. Author

N65-12072# Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.
RESEARCH AND DEVELOPMENT ON PHOTOCONDUCTIVE PHOTO-TAPE Interim Report, May 1–Jul. 30, 1964
Aug. 1964 69 p refs
(Contract AF 33(657)-11485)
(IR-3; AD-605366)

In the effort to advance the Photo-Tape program toward a flight-demonstration-model camera, the overall engineering objectives can be divided into two primary areas—the first is the demonstration of specified performance levels, and the second is the demonstration of the feasibility of building higher-performance cameras based on the Photo-Tape concept, by employing laboratory models of individual components. The Photo-Tape research includes studies of electron optics, flood guns, vacuum bearings, and tape reflectivity measurements; photoconductor research includes demountable tests and electroded samples. In the electron-gun research program, a new gun structure was designed and fabricated for use with small-area cathodes, and with the stub-cathode in particular. Three stub-cathode guns were built and tested; high beam currents were obtained from all three. D.S.G.

N65-12092# Philco Corp., Lansdale, Pa.
RESEARCH AND DEVELOPMENT TO OBTAIN SEMICONDUCTOR DIODES FOR ELECTRONIC TUNING Second Interim Engineering Report, 27 Sep.–26 Dec. 1963
[1963] 61 p refs
(Contract NObsr-89508)
(R-182.1; AD-424151)

The semiconductor diodes are being made by planar epitaxial silicon technology with diffusion of a heavily doped p-type region into an n-type layer on an n^+ substrate. Two proposed structural changes, involving the guard-ring structure and the double-epitaxial-layer structure, are discussed in detail. Generalizations made from consideration of the distribution of electrical characteristics as measured on unsealed diodes and on encapsulated diodes include the following: (1) The combination of structural and processing changes now in use is producing substantially increased yields of diodes with breakdown voltage of 200 volts or higher. (2) Capacitance change with temperature is generally below 200 ppm/° C maximum. P.V.E.

N65-12095 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ELECTRICAL CONDUCTIVITY AND THERMOELECTROMOTIVE FORCE OF SOLID SOLUTIONS OF THE SYSTEMS: Bi_2Se_3–Sb_2Te_3 AND Bi_2Te_3–Sb_2Se_3
V. G. Kuznetsov, K. K. Palkina, and A. V. Dmitriyev 22 Apr. 1964 14 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 8, no. 9, 1963 2136–2139
(FTD-MT-64-08; AD-602602) OTS: $1.00

On the basis of measurements of electrical conductivity and thermal emf of solid solutions with laminar structure of the tetradymite type, it was established that in the system Bi_2Se_3–Sb_2Te_3, the electrical conductivity has a minimum at approximately 70 mole % Sb_2Te_3. The thermal emf increases from -60 to -116μv/deg with increasing Sb_2Te_3 content up to 50 mole %; at approximately 60 mole % the sign of the conductance changes from minus to plus, and a maximum of $+360\mu$v/deg is reached at about 70 mole %. In the system Bi_2Te_3–Sb_2Se_3, electrical conductivity decreases with increasing concentration of Sb_2Se_3 on a smooth curve, and thermal emf increases from 100 to 127μv/deg up to 50 mole % of Sb_2Se_3, then decreases rapidly to 6μv/deg at 70 mole %. The temperature behavior of electrical conductivity in the range 18° to 227° C for compounds Bi_2Te_3, Bi_2Se_3, and Sb_2Te_3 is of the metallic type, whereas Sb_2Se_3 is of the semiconductor type with a forbidden zone width of 1.2 eV. D.S.G.

N65-12111# Bliley Electric Co., Erie, Pa.
PRODUCTION ENGINEERING MEASURE: QUARTZ CRYSTAL UNITS, CR-(XM-40) (2.5 MC HIGH PRECISION) Eighth and Ninth Quarterly Report, 1 Mar.–31 Aug. 1963
J. M. Wolfskill, R. T. Schlaudecker, and Robert Mouck [1963] 46 p
(Contract DA-36-039-SC-85958)
(AD-423537)

Preproduction testing of ten sample units, seven made from natural quartz and three made from cultured quartz, is discussed. Requirements are listed, test equipment is noted, and the test results are presented. All units tested met the ± 5 parts in 10^{10} per day aging requirement and all other requirements, except that the cultured quartz units exceeded the maximum permitted value of the resistance requirement. It is concluded that it is not practical to meet the CR-(XM-40)/U resistance requirement with any currently available cultured quartz material. P.V.E.

N65-12120# Boeing Scientific Research Labs., Seattle, Wash.
SOLID STATE PHYSICS LABORATORY PROGRESS REVIEW, FIRST SIX MONTHS 1964

H. Brunner, M. J. Blackburn, C. M. Carlson, Y. F. Cheng, J. C. Erdmann et al Aug. 1964 33 p refs

A new theory is developed to refute the Kroenig theory of the X-ray-absorption fine structure for solids for the case of both the amorphous and the crystalline form of germanium. An improved calorimetric technique applicable at cryogenic temperatures to sensitivities of better than 10^{-7} calories is presented, for use in the detection of microstrain in the elastic region of metals. The factors influencing the shape, wavelength, and other characteristics of annealed copper-nickel alloys were studied by the utilization of the "Moessbauer effect" spectrometer. Also presented are phase transformation and disorder–order transformation studies of titanium alloys. G.G.

N65-12125# Naval Ordnance Lab., White Oak, Md.
GUIDED EM MODES IN A PN JUNCTION DEPLETION LAYER
Alan H. Luther Nov. 1964 27 p refs
(NOLTR-64-129; AD-448300)

The problem of guided electromagnetic wave modes in a three-layer dielectric sandwich is discussed. General solutions are found in terms of the dielectric constants, central layer width, and frequency. The solutions are valid for media with small loss tangents. These results are then applied to the electromagnetic wave modes guided along the depletion layer of a p-n junction. Author

N65-12142# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center
NIOBIUM. DATA SHEETS
Donald L. Grigsby Nov. 1964 111 p refs
(Contract AF 33(615)-1235)
(DS-141; AD-608398)

These data sheets present a compilation of a wide range of electrical and magnetic properties for niobium of various purities in bulk and film form. Electrical properties include conductivity, resistivity, Hall coefficient, and transition temperature. Magnetic properties include susceptibility, hysteresis, and threshold field. Emission and energy data include thermionic properties, photon emissivities, absorption, and energy gap. Debye temperature and thermal conductivity data are also given. Each property is compiled over the widest possible range of parameters from references obtained in a thorough literature search. A summary of physical properties has been added. Author

N65-12182# Iowa State U. of Science and Tech., Ames Ames Lab.
FACTORS AFFECTING THE GROWTH AND THE MECHANICAL AND PHYSICAL PROPERTIES OF BISMUTH SINGLE CRYSTALS
Robert E. Slonaker, Jr. and Morton Smutz Jul. 1964 87 p refs
(Contract W-7405-ENG-82)
(IS-964)

Single crystals of bismuth were grown under various sets of conditions to ascertain some of the variables influencing the mechanical and physical properties of the crystals. Bismuth was chosen as the material to be investigated because of its relatively low melting point, relatively low chemical reactivity, and because it possesses the interesting feature of undergoing expansion during solidification. The Bridgman technique was chosen as the recrystallization method in order to provide shaped samples desired for tensile tests. The results led to the following conclusions: (1) Material purity has a definite, and perhaps dominant, influence on the probability of crystal-growth success. (2) The rate of crystallization has no apparent effect on the orientation of the crystal lattice with respect to the direction of growth. (3) The critical resolved shear stress was greater, and the resistivity ratio was less for crystals grown with faster crystallization rates. (4) The behavior of single crystals during tensile testing was dependent on the angle between the primary cleavage plane and direction of load application. D.S.G.

N65-12223# Michigan U., Ann Arbor Cooley Electronics Lab.
IMPEDANCE AND RADIATION CHARACTERISTICS OF A FERRITE OBSTACLE IN THE APERTURE OF A RECTANGULAR WAVEGUIDE Technical Report No. 146
J. C. Palais (Ph.D. Thesis) Aug. 1964 205 p refs
(Contract DA-36-039-AMC-03733(E))
(Rept.-6137-3-T; AD-606189) OTS: $6.00

The radiation characteristics of a ferrite cylinder in the aperture of a rectangular waveguide were analyzed, and a mathematical basis for the beam shifting property and the involved mechanism was found. A new, single element, electronic scanning antenna was developed to confirm the predicted beam shifting properties, and a mathematical analysis of the reflection coefficient of the structure was made. Extensions of the dual discontinuity method to other problems are discussed. G.G.

N65-12226# General Electric Co., Ltd., Wembley (Gt. Brit.) Central Research Labs.
C.V.D. RESEARCH PROJECT RP3-38: AN X-RAY TOPOGRAPHICAL STUDY OF POLYTYPISM IN SILICON CARBIDE CRYSTALS
C. A. Wallace 8 Apr. 1964 22 p refs
(Contract CP 4D/9293/6-0/47/DPR)
(Rept.-14-589C; AD-444048)

Conventional X-ray methods of determining the crystal structure of silicon carbide crystals suffer from the disadvantage that only a small area of the crystal can be sampled at a time. Since these crystals often consist of a mixture of different isomorphous structures or polytypes, the area examined may be quite unrepresentative of the crystal as a whole. It is also difficult to define precisely the area sampled or to differentiate epitaxial growth from seed material. A new method has been developed based on the techniques of X-ray diffraction topography. This enables the topographical distribution of polytypes present in the principal surfaces of the crystal to be observed directly, by means of the X-ray images produced by the different polytypic domains. After reviewing the crystal structure of silicon carbide, this report describes both the conventional and topographical X-ray techniques, and their application to a selected crystal, C46XI, both before and after overgrowth by deposition from the liquid phase. Polytype maps have been constructed showing the configuration of the domains of 6H and 15R polytypes before and after overgrowth. Author

N65-12247# Alfred U., N.Y. Coll. of Ceramics
THE STRESS-STRAIN BEHAVIOR OF STRONTIUM ZIRCONATE Bimonthly Progress Report, May 15–Jul. 15, 1964
J. E. Funk, J. Nemeth, and J. R. Tinklepaugh [1964] 12 p refs
(Contract NOw-64-0051-d)
(BMPR-5; AD-605424)

The thermal expansion of both chemically pure and commercial $SrZrO_3$ in hot-pressed polycrystalline form has been determined. These measurements are not entirely in agreement with those obtained by X-ray powder techniques. Efforts to grow single crystals of $SrZrO_3$ have continued. Author

N65-12260# South Dakota School of Mines and Tech., Rapid City
THE THERMAL CONDUCTIVITY AND SEEBECK COEFFICIENT OF SOME CUBIC SODIUM TUNGSTEN BRONZES
Howard R. Shanks 1 Sep. 1964 58 p refs
(Contract Nonr-2964(01))
(TR-12; AD-606506)

The thermal conductivity and Seebeck coefficient of two cubic sodium tungsten bronze samples (Na_xWO_3) with x-values of 0.513 and 0.804 were measured in the temperature range of 350° to 700° K. The thermal conductivity measurements were made using a series comparative method with Armco iron as the standard. The Seebeck coefficients were calculated from the measured Seebeck voltages of the bronze samples with respect to Chromel and Alumel and the known Seebeck coefficients of Chromel and Alumel. The thermal conductivities of both samples were found to increase with increasing temperature with a discontinuity between 400° and 500° K. The positive temperature coefficients were interpreted as a combination of electron and phonon conduction, both limited by impurity scattering. The discontinuity was interpreted as a disordering of the sodium atoms. Author

N65-12277# Kansas U., Lawrence
[SPIN-LATTICE RELAXATION AND NUCLEAR ORIENTATION IN SINGLE CRYSTALS] Status Report, 1 Mar.–1 May 1964
R. C. Sapp and J. W. Culvahouse 3 Jun. 1964 2 p ref
(Contract Nonr-2775(00))
(AD-602252)

Reported is the reexamination of data for the spin-lattice relaxation time for Nd^{3+} ions in Nd-Mg nitrate, indicating good agreement with Orbach's theory and preliminary studies of Co^{2+} ions in La-Co nitrate for both perpendicular and parallel orientation of the steady magnetic field H relative to the trigonal crystal axis. Nuclear orientation studies were concentrated on anisotropy and linear polarization measurements on a spherical single crystal of Ce-Mg nitrate containing Ce^{139}. Microwave resonance and relaxation studies reported include a more precise calculation of the theory of spin-lattice relaxation for the Y ion, accumulation and analysis of data on the relaxation of divalent cobalt in $ZnSiF_6 \cdot 6H_2O$, preliminary measurements on Fe^{3+} in MgO, and measurement of the hyperfine splitting of Fe^{57} in the impurity sites of $La_2(Zn)_3(NO_3)_{12}24H_2O$. M.R.G.

N65-12320*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
NON-HOOKEAN, PREMACROYIELD STRESS-STRAIN BEHAVIOR OF SEVERAL IONIC SINGLE CRYSTALS
Carl A. Stearns and Edward R. Gotsky Washington, NASA, Dec. 1964 21 p refs
(NASA-TN-D-2545) OTS Prices: HC $1.00/MF $0.50

The premacroyield compressive stress–strain behavior of sodium chloride, potassium bromide, lithium fluoride, potassium chloride, and magnesium oxide was studied with a refined apparatus possessing microstrain sensitivity. The stress–strain curve was found to be characterized by a general S-shape through the onset of macroyielding, a lack of linearity during loading and unloading, and very low tangent moduli in the region usually considered to be elastic. The extent of the initial concave-upward region of the stress–strain curve was found to vary with specimen pretreatment, rate of testing, and prestress. Successive loading-unloading tests revealed that closed hysteresis loops result after cycling. No indication of a critical stress for overcoming Peierls–Nabarro-type barriers was observed. The experimental results are interpreted in terms of internal stresses arising from dislocation configurations. Author

N65-12325# Iowa State U. of Science and Tech., Ames Ames Lab.
MAGNETIC ANISOTROPY IN DYSPROSIUM SINGLE CRYSTALS
Terry Ting Jew and S. Legvold Feb. 1963 50 p refs
(Contract W-7405-ENG-82)
(IS-867)

Two single crystals were grown by using the strain-anneal technique. Three rectangular parallelepiped samples were cut from these crystals with the long dimension directed along one of the hexagonal axes. These are designated as the $<11\bar{2}0>$ a-axis, the $<10\bar{1}0>$ b-axis, and the <0001> c-axis. Magnetic measurements were made on the a-axis and the b-axis samples with the field up to 18 kilo-oersteds applied along the long dimension of the samples at temperatures from 4.2° to about 330° K. The a-axis was found to be the direction of easy magnetization while the c-axis is very hard magnetically. Magnetic anisotropy was observed in the magnetization curves below 110° K, and above 110° K it gradually disappeared. In a plot of magnetic moment versus temperature a Néel temperature was observed at 178.3° K. Electrical resistivity measurements were made on the b-axis and c-axis samples. Both the c-axis and b-axis resistivity curves exhibit an abrupt change in slope at 88.4° K, which indicates the ferromagnetic-antiferromagnetic transition temperature. A Néel temperature of 179.6±1° K was found from the change of slope of the b-axis resistivity curve. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-11117# IIT Research Inst., Chicago, Ill.
A STUDY OF THE FUNDAMENTALS OF LIQUID PROPELLANT SENSITIVITY Third Technical Progress Report
Ted Erikson 15 Jul. 1964 27 p refs
(Contract AF 04(611)-9566)
(IITRI-C6024-12; AD-445350)

Shock-tube tests with approximately 0.1-g samples of Compound R at initial temperatures near −180° C were performed with measured induction times of 0 to 1 msec; a 400μsec time delay from shock reflection to detonation was measured for six identical tests at an incident nitrogen shock near Mach 2.4 with less than 10μsec deviation. The initial mode of initiation by the shock-tube test is either energy transfer to, or heterogeneous attack at, the surface of the condensed phase. Increased gas temperature will increase the initial energy flux but will decrease the rate of heterogeneous attack. The maximum energy accumulation during the conditions for the 400μsec delay time by energy transfer is 8.33 cal/cm^2. Assuming a 10 kcal/mole heat of heterogeneous reaction, the corresponding energy accumulation is 30 cal/cm^2. Author

N65-11271# Stanford Research Inst., Menlo Park, Calif.
THE ROLE OF ALUMINUM AND ITS OXIDES AS SOURCES OR MODERATORS OF ELECTRONS IN ALUMINIZED SOLID PROPELLANT ROCKET EXHAUSTS, PART 2 Final Report
G. Neil Spokes Aug. 1964 25 p refs
(Contract AF 04(694)-128)
(SSD-TDR-63-326, Pt. II; AD-447283)

A brief summary of previously reported work is given. Further calculations of electron distributions about a thermionically emitting particle are appended. Author

N65-11424# Aerospace Corp., El Segundo, Calif. Electronics Div.
EXPERIMENTAL PERFORMANCE OF ANHYDROUS AMMONIA
D. J. Griep 12 Oct. 1964 20 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-239; TDR-469(5230-33)-1; AD-451081)

The measured sea-level performance of anhydrous ammonia gas as an attitude control system propellant is presented. The specific impulse for low-thrust operation in the steady-state and pulse-operating modes is described. The application of anhydrous ammonia as an attitude control propellant is also discussed. Author

N65-11806# Stanford Research Inst., Menlo Park, Calif.
SOLID PROPELLANT MECHANICAL PROPERTIES INVESTIGATIONS Quarterly Progress Report No. 3, Apr. 1–Jul. 1, 1964
Norman Fishman and James A. Rinde 4 Aug. 1964 43 p refs
(Contract AF 04(611)-9559)
(Rept.-9; AD-604109)

Equations of finite elastic theory were developed and used to analyze propellant test results. Findings on the degree of deviation of experimental data from calculated curves are presented. By performing the appropriate operations on test results, a path-independent equation was developed that interrelates volume ratio, strain energy, and time for each propellant composition. Constant volume envelopes plotted as log stress versus log strain were shown to depend on path, since constant load data did not fall on the envelopes defined by constant strain-rate data and constant loading-rate data. D.E.W.

N65-11810# California Inst. of Tech., Pasadena W. M. Keck Lab. of Engineering Materials
A RESEARCH PROGRAM ON SOLID PROPELLANT PHYSICAL BEHAVIOR Quarterly Report No. 3, 1 May–30 Jul. 1964
M. L. Williams et al Aug. 1964 5 p refs
(Contract AF 04(611)-9572)
(MATSCIT-PS-64-7; AD-605202)

The research program in the following areas is discussed: (1) behavior of polymeric and composite systems—experimental and theoretical studies on rubberlike materials; (2) standardized material characterization—determination of mechanical and swelling properties, and mathematical descriptions of material properties; and (3) data information—preparation of abstract publication on the structural integrity of solid propellants. D.S.G.

N65-12178# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
FIRE AND EXPLOSION HAZARDS OF FLIGHT VEHICLE COMBUSTIBLES Quarterly Progress Report, Apr. 1–Jun. 30, 1964
E. L. Litchfield and H. E. Perlee [1964] 11 p refs
(Contract DO-33(615)-64-1007)
(QPR-2; AD-603130) OTS: $1.00

In studying the suppression of cryogenic propellant explosions, the shock sensitivity of liquid hydrogen with solid oxygen and solid nitrogen, and with solid oxygen and solid methyl chloride, was investigated. Also studied were the explosive initiation of liquid hydrogen with solid oxygen and solid nitrogen, and the shock sensitivity of lox with solidified kerosene, solidified butane, liquefied propane, and solid butane and solid methyl chloride, solid kerosene, and ice. Also discussed are the suppression of gas-phase detonation by inert-powder additives and the flammability of halogenated hydrocarbons at elevated temperatures. P.V.E.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-11132# Air Force Systems Command, Wright-Patterson AFB, Ohio Ramjet Div.
INLET EFFICIENCY PARAMETERS FOR SUPERSONIC COMBUSTION RAMJET ENGINES Technical Documentary Report, Nov. 1962–Apr. 1963
E. T. Curran and M. Brian Bergsten Jun. 1964 52 p refs
(APL-TDR-64-61; AD-606653)

The various definitions of inlet efficiency, which are currently in use for supersonic combustion ramjet engines, are surveyed. Derivations of each of these parameters and the relationships between them are presented. Charts for the conversion from one parameter of efficiency to another are included. These charts are based on real gas properties. Attention is drawn to the application of available energy concepts to the supersonic combustion ramjet engine, and a definition of inlet effectiveness is introduced. Author

N65-11188# General Electric Co., Lynn, Mass. Instrument Dept.
PROCESSING OF ENGINE DATA FOR DEVELOPMENT OF TURBOJET ENGINE ANALYZER. PART I: PROCESSING OF J79-7 ACCELERATED SERVICE AND J79-7A ENGINE DURABILITY TEST DATA Final Report
M. E. Douglass Wright-Patterson AFB, Ohio, Systems Eng. Group, Aug. 1964 94 p
(Contract AF 33(657)-11043)
(SEG-TDR-64-11, Pt. I; AD-606033)

This report describes a method of determining the condition of jet engines through the measurement of performance sensitive parameters, and shows the results of applying the analysis techniques to data acquired during accelerated service tests of a J79-7 engine in an F104 airplane. The results of the evaluation are encouraging in that minor deteriorations not observed by either pilot or ground crew but discovered on scheduled detailed inspection were properly indicated by the fault isolation techniques. Author

N65-11241# Rocketdyne, Canoga Park, Calif.
DEVELOPMENT OF DOWNRATED ATLAS YLR101-NA-15 VERNIER ENGINE Final Report
J. J. Griffin 8 Nov. 1963 146 p
(Contract AF 04(695)-306)
(R-5316; AD-423340)

Presented is a summary of test results from a program to develop the YLR101-NA-15 vernier engine. The program was completed in three phases; downrating the tank-fed thrust of the YLR101-NA-13 vernier from 830 lbs to 525 lbs, modifying and repackaging the 525-lb-thrust vernier into the YLR101-NA-15 configuration, and developing a modified vernier injector to minimize a thrust chamber erosion problem that occurred at the 525-lb-thrust level. Author

N65-11307*# National Aeronautics and Space Administration, Washington, D.C.
THE BELIER, CENTAURE AND DRAGON ROCKET ENGINES

Nov. 1964 17 p Transl. into ENGLISH of a report of CNET, Sud Aviation, Mar. 1961
(NASA-TT-F-9161) OTS Prices: HC $1.00/MF $0.50

Included in the description of the Belier rocket engine are its normal intended use; general characteristics; descriptions of the booster, ring, and fins; self-destruction provisions; dimensions; weights under various conditions; descriptions of guidance, piloting, and stabilization devices; energy sources; disposable useful load; ground transportation for the rocket; handling methods; launching; and recovery. Service equipment is discussed; performance characteristics in normal use, in space, and during remote launchings are given; and the state of progress in construction of rockets is reported. Information is given in identical format for the Centaure and Dragon rockets. The Belier carries an expendable payload of 32 kg and weighs 315 kg on the launching ramp. The Centaure is a small booster for the Belier, and weighs 152 kg before launch. The Dragon is a larger booster for the Belier, and weighs 838 kg before launching. D.E.W.

N65-11311*# National Aeronautics and Space Administration, Washington, D.C.
EXPERIMENTAL ROCKETS, AN AUXILIARY TEACHING AID [LES FUSEES EXPERIMENTALES, MOYEN AUXILIAIRE D' ENSEIGNEMENT]
Lise Blosset Nov. 1964 47 p Transl. into ENGLISH of a paper presented at the 15th Intern. Astronautical Cong., Warsaw, 7-12 Sep. 1964
(NASA-TT-F-9173) OTS Prices: HC $2.00/MF $0.50

This is a report on rocket experiments designed for young people by the National Center of Space Studies. Proposed are measurements concerning the performance of the rocket itself, the development of recovery methods for the rocket and its payload, and the use of complex instruments. The aim of this program is to interest youth groups and individuals in the simple basic principles of rocket research and help them to carry out valuable experiments in complete safety. G.G.

N65-11316# Boeing Co., Seattle, Wash.
ELECTRICAL PROPULSION HANDBOOK. VOLUME IV: CHARACTERISTICS OF ELECTROTHERMAL PROPULSION
S. L. Kessler [1962] 63 p refs
(D2-20646, Vol. IV; AD-444650)

This paper presents a broad study of the arc jet engine, operating with gases in a forced rather than a free convection. The following topics are discussed: "Introduction"—description of arcs, arc stabilization, engine performance limitations, efficiency considerations, and engine cooling; "Engine Parameters"—specific impulse, overall engine efficiency, power-to-thrust ratio, and heat transfer; "Typical Electrode Configuration—dc and ac arc; "Engine Materials"—electrodes, insulation, and housing; "Propellants"; "The Resitojet"; "The R-F Heated Plasma Torch"; and "Active Engine Development Contracts." The various electric arcs and their characteristics are presented in an appendix. G.G.

N65-11479# Radio Corp. of America, Burlington, Mass. Aerospace Communications and Controls Div.
GIMBALLED VS FIXED ENGINE INVESTIGATION Interim Technical Report
R. Batchelder et al 2 Aug. 1963 249 p refs
(Contract AF 04(695)-273)
(CR-29; AD-602869)

This report contains the results of a study of 8 different types of thrust-vector altitude-control systems for space vehicle applications. Expected constant and sinusoidal disturbance moments are derived. The linear disturbance feedback from propellant sloshing is derived. The methods of determining disturbance inputs from structural vibration and system noise are outlined. The dynamic effects of the linear disturbance feedback from propellant sloshing are analyzed, and modifications to the control system designs are made when necessary to insure system stability. The transient responses of the linear systems to a step disturbance moment are calculated. The relative efficiency, weight, and complexity of fixed versus gimballed systems are analyzed for two arbitrarily selected thrust levels. The effects of gimbal angle limitations on the performance of the control system used for the gimballed engine with hinge line ahead of the vehicle cg are examined. The effects of vehicle parameters are discussed, and the transient responses of the four linear systems are calculated. Author

N65-11482# Curtiss-Wright Corp., Wood-Ridge, N.J. Wright Aeronautical Div.
SUPERSONIC TRANSPORT PROPULSION SYSTEM CONTINUED RESEARCH AND STUDY OF HIGH TEMPERATURE TURBINE AND EXHAUST NOZZLE NOISE. VOLUME II: EXHAUST NOZZLE NOISE PROGRAM Third Quarter Progress Report, 15 Oct. 1963–15 Jan. 1964
15 Feb. 1964 31 p refs
(Contract AF 33(657)-9058)
(SQ-3-II; AD-602534)

The principal accomplishments discussed include continuation of noise testing, initiation of thrust testing, and reduction and analysis of data from testing conducted on the new concepts for noise suppression in the existing convergent plug-type nozzle model, and completion of fabrication and a portion of the thrust testing of a new convergent-divergent plug-type model. Author

N65-12014# Aerojet-General Corp., Sacramento, Calif. Liquid Rocket Operations
DEVELOPMENT OF A VARIABLE-LENGTH CHAMBER FOR LIQUID ROCKET COMBUSTION RESEARCH, VOLUME 3 Product Engineering Final Report, 1 Jun. 1963–1 Aug. 1964
Allan J. Smith, Jr. and Frederick H. Reardon Oct. 1964 95 p refs *Its* Rept.-212/SA3-F, Vol. 3
(Contract AF 04(694)-212/SA19)
(BSD-TDR-64-137; AD-450547)

A variable-length combustion chamber has been developed that is capable of continuously changing length while firing. The combustion chamber is 6 in. in diameter; its length is variable between 7 and 24 in. It has been tested with the hypergolic propellant combination of nitrogen tetroxide and Aerozine 50. The tests were conducted with a like-on-like injector pattern that was designed to be similar to one developed early in the second-stage Titan II program. Five tests were conducted. Four tests at 500-psia chamber pressure covered the mixture ratio range of 1.87 to 2.1. The fifth test was conducted at a pressure of 850 psia and a mixture ratio of 1.62. These tests successfully demonstrated the length variability and hot-gas sealing concepts. In addition, excellent static pressure measurements of the energy release distribution were obtained. These measurements showed that a large fraction of the energy release occurred close to the injector face, but that combustion was not completed until 13 in. from the face. The primary objective of the program was to determine whether the results of subscale testing of longitudinal-mode stability limit can be applied to the prediction of the stability of all modes in a full-scale thrust chamber. However, no combustion instability was encountered in the test program. Therefore, a positive evaluation of the technique could not be achieved. Author

N65-12023# Illinois U., Urbana Charged Particle Research Lab.
ELECTRICAL SPRAYING OF MACROSCOPIC LIQUID PARTICLES UNDER PULSED CONDITIONS
Ralph S. Carson 15 Jan. 1964 56 p refs
(Grants NSF G-19776; AF-AFOSR-107-63)
(AFOSR-64-1470; AD-604428)

It was found that glycerine, Octoil, and Octoil doped with tetra-n-butylammonium picrate readily spray from the end of a fine capillary, maintained at a high dc potential, in short periodic bursts that continue over a prolonged time interval of at least several hours. The dependence of the naturally pulsed spraying on applied voltage, on liquid constants and pressure, and on the geometry of the apparatus is determined by observing the spraying current; typical results are given. New techniques are presented for determining the specific-charge spectra of the droplets emitted in selected intervals during the spraying pulses by time-of-flight mass spectrometry, and for taking photomicrographs of the liquid surface at any instant before, during, and after the spraying pulses. A method for synchronizing the spraying to an external pulser is indicated. Author

N65-12071# Marquardt Corp., Ogden, Utah
RESULTS OF THE PHASE II LONG-TERM ENVIRONMENTAL STORAGE TEST PROGRAM FOR THE RJ43-MA-11 RAMJET ENGINE, OCTOBER 1960 THROUGH OCTOBER 1963
W. A. Whitney 24 Oct. 1963 89 p refs
(Contract AF 33(657)-7770)
(Rept.-15084; AD-423790)

Tests conducted consisted of subjecting the RJ43-MA-11 engine to accelerated storage under severe environmental conditions and long-term storage under actual tactical environment conditions. Effects of the environmental tests on engine performance and structural integrity were evaluated by a comparison of prestorage and poststorage power-control-system calibration data, by an engine combustion performance test, and by complete disassembly and inspection of the test items for any signs of deterioration. Author

N65-12108*# General Applied Science Labs., Inc., Westbury, N.Y.
REVIEW OF PROBLEMS IN APPLICATION OF SUPERSONIC COMBUSTION
Antonio Ferri [1964] 111 p refs Presented at 7th Lanchester Mem. Lec., Roy. Aeron. Soc., London, 14 May 1964
(Contracts NAS8-2686; AF 49(638)-991; AF 33(657)-10463)
(NASA-CR-59662; AFOSR-64-1471; AD-604441)

The following are discussed with respect to the performance of supersonic combustion ramjets: (1) possible air-breathing engine schemes; (2) comparison of subsonic and supersonic combustion ramjets; (3) possible performances of supersonic burning ramjets; and (4) aerodynamic heating. The discussion of supersonic combustion includes the following subjects: (1) description of supersonic combustion controlled by mixing—diffusion and heat convection; (2) reaction process analysis—determination of reaction times; and (3) mixing processes analysis—mixing of nonreacting flows, mixing with pressure gradients, and mixing with combustion. It is concluded that the supersonic ramjet scheme has good characteristics as a hypersonic engine. P.V.E.

N65-12119# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Chemical Propulsion Information Agency
PROCEEDINGS OF THE SIXTH MEETING OF THE ICRPG WORKING GROUP ON DESIGN AUTOMATION
Ronald D. Brown et al [1964] 9 p Meeting held at NASA. Langley Research Center, Langley Station, Va., 7 Nov. 1963
(AD-602882)

Abstracts of reports presented at the meeting are given. Included are the following: (1) "Solid Rocket Propulsion System Optimization Study"; (2) "Generalized Three-Dimensional Grain Design Program"; (3) "Program Integration Committee Report"; and (4) "Program Inventory Committee Report." D.S.G.

N65-12291# McGill U., Montreal (Canada)
HYPERSONIC PROPULSION LABORATORY Annual Report, 1964
S. Molder et al Nov. 1964 48 p refs
(Grant DRB-9550-06)
(Memo-64-1)

Discussed is work being carried out in an attempt to provide basic data on diffusion of hypersonic airstreams, energy addition to high enthalpy air, acceleration of chemically reactive gases in a propelling nozzle, and heat transfer rates. Brief summaries of various research projects are presented. The projects are divided into two types: (1) research on problems concerned with hypersonic air-breathing engines; and (2) development of basic test facilities and their instrumentation. P.V.E.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-11145*# Stanford U., Calif. Stanford Electronics Lab.
RADAR ASTRONOMY OF SOLAR SYSTEM PLASMAS Scientific Report No. 4
Von R. Eshleman Aug. 1964 51 p refs
(Grant NsG-377)
(NASA-CR-59535; SU-SEL-64-104) OTS Prices: HC $3.00/MF $0.50

The subject of this paper is the study, by radar techniques, of gaseous regions in the solar system. The interplanetary medium, the solar corona, and planetary atmospheres and ionospheres are considered. The past experimental results are reviewed. Most of the regions of interest contain gases which are wholly or partially ionized, so that the radar techniques of study involve propagation of electromagnetic waves in a plasma. However, a consideration of propagation in non-ionized portions of planetary atmospheres is also included since, under certain conditions, both atmospheric and ionospheric perturbations to the radar waves will be important. The atmosphere and ionosphere of the earth are considered only with respect to their effects on the measurements of more distant regions. Both monostatic and bistatic radar astronomy techniques are discussed. Author

N65-11302*# Consultants and Designers, Inc., Arlington, Va.
MAGNETIC FIELDS AND THE FINE STRUCTURE OF THE CHROMOSPHERE IN THE ACTIVE REGION [MAGNITNYYE POLYA I TONKAYA STRUKTURA KHROMOSFERY V AKTIVNOY OBLASTI]
T. T. Tsap 3 Nov. 1964 12 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 31, 1964 p 200–208
(Contract NAS5-3760)
(NASA-TT-F-8984; ST-SP-10233) OTS Prices: HC $1.00/MF $0.50

The orientation of the fine structure of the chromosphere in active region of the sun has been studied by using registrations of the transverse magnetic field and the H_α spectroheliograms. It was found that the orientation is determined by the force effect of the magnetic field that penetrates the chromosphere. Author

N65-11303*# Consultants and Designers, Inc., Arlington, Va.
MAGNETIC FIELD IN A FLUID OF INFINITE CONDUCTIVITY PLACED IN A UNIFORM GRAVITATIONAL FIELD [LE CHAMP MAGNETIQUE DANS UN FLUIDE DE CONDUCTIVITE INFINIE PLACE DANS UN CHAMP GRAVITATIONNEL UNIFORME]
Donald Mc Lean 6 Nov. 1964 8 p ref Transl. into ENGLISH from Ann. Astrophys. (Paris), v. 27 no. 4, 1964 p 195–197
(Contract NAS5-3760)
(NASA-TT-F-8985; ST-SP-PP-10234) OTS Prices: HC $1.00/MF $0.50

This paper describes a simple class of equilibrium configurations of a magnetic field in a fluid of infinite conductivity that is subject to a uniform gravitational force. This class is typified by a tube of force, surrounded by a region of zero magnetic field, and supported by the pressure gradient in the fluid. The form of such a tube is shown. Author

N65-11327# Alaska U., College Geophysical Inst.
HIGH LATITUDE VLF PROPAGATION Final Report
Howard F. Bates and Paul R. Albee Jul. 1964 166 p refs
(Contract NBS-CST-7338)
(UAG-R154; AD-448306)

A major part of the information discussed is the data obtained over a 1-year period (1963), using a rubidium vapor oscillator as the frequency standard. The vlf variations observed are divided into two categories: (1) effects known to be associated with a particular type of event; and (2) those that occur regularly with no apparent connection to geophysical disturbances. Discussions of observations in the first category include vlf phase anomalies produced by solar-flare X-rays, solar-flare cosmic rays (which produce the polar cap disturbances), solar eclipses, and nuclear explosions. The second category includes regularly occurring (primarily at night) phase anomalies. Evidence is presented that these interferences are the result of phase interference, and a model is presented in which appreciable mode conversion or coupling between ordinarily independently propagating waves occurs at some sort of D-region disturbance. No statistical relationship between geomagnetic disturbances and vlf phase variations was found. It is concluded that the long-distance vlf method is a good detection system for certain events such as cosmic-ray flares, solar-flare-induced ionospheric disturbances, and nuclear explosions, and that it is a useful tool, in conjunction with other methods, for determining properties of the upper atmosphere or of the various D-region disturbances. M.P.G.

N65-11365*# California U., San Diego
HIGH ENERGY COSMIC PHOTONS AND NEUTRINOS
R. J. Gould and G. R. Burbidge [1964] 80 p refs Presented at the I.A.U. Symp. on Astronomical Observations from Space Vehicles, Leige, Aug. 1964 Submitted for Publication
(Grant NsG-357)
(NASA-CR-59550) OTS Prices: HC $3.00/MF $0.75

This review concentrates primarily on the problem of interpreting the recent X-ray and γ-ray observations of celestial sources. The expected fluxes of hard radiation from various processes are estimated (when possible) and are compared with the observations. We compute the synchrotron, bremsstrahlung, and (inverse) Compton spectra originating from relativistic electrons produced (via meson production) in the galaxy and intergalactic medium by cosmic ray nuclear collisions; the spectra from π^0 -decay are also computed. Neutron stars, stellar coronae, and supernova remnants are reviewed as possible X-ray sources. Special consideration is given to the process in the Crab Nebula. Extragalactic objects as discrete sources of energetic photons are considered on the basis of energy requirements; special emphasis is given to the strong radio sources and the possibility of the emission of hard radiation during their formation. The problem of the detection of cosmic neutrinos is reviewed. As yet, no definite process can be identified with any of the observed fluxes of hard radiation. Author

N65-11566*# California U., San Diego
ULTRAVIOLET EMISSION FROM GALAXIES
E. Margaret Burbidge [1964] 19 p refs Presented at the 4th Session of I.A.U. Symp. No. 23 on "Astron. Observations from Space Vehicles", Liège, 1964
(Grant NsG-357)
(NASA-CR-59601) OTS Prices: HC $1.00/MF $0.50

The ultraviolet radiation from normal elliptical, spiral, and irregular galaxies, and from abnormal objects (radio sources, quasi-stellar objects, and Seyfert galaxies) is discussed. A list of expected emission lines is compiled from previously published lists for planetary nebulae. The problem of the passage of Lyman α radiation from the source to the observer is reviewed, and possible Lyman α fluxes from various types of normal and abnormal galaxies are estimated for the case that most of the Lyman α generated in the source can escape from it. The abnormal galaxies should be the stronger Lyman α emitters. Finally, it is shown that quasi-stellar radio sources in the apparent visual magnitude range 17 to 19 can have redshifts in the range $z = 1$ to 2, and Lyman α can come into the wavelength region accessible from the ground. To facilitate line identifications in existing spectra of such objects, ultraviolet spectra of planetary nebulae and of the relatively bright object 3C273 are greatly needed. Author

N65-11642# State U. of Iowa, Iowa City
RADIATION OBSERVATIONS WITH SATELLITE 1958 EPSILON
James A. Van Allen, Carl E. Mc Ilwain, and George H. Ludwig [1958] 54 p refs Submitted for Publication Sponsored by Natl. Acad. of Sci., NSF, Army, ONR, and AEC
(SUI-58-10; AD-224901)

Radiation observations made with Satellite 1958 Epsilon are presented under the following headings: (1) "Introduction"; (2) "Apparatus for 1958 Epsilon"; (3) "Orbit of 1958 Epsilon"; (4) "Data Transmission and Reception"; (5) "Observations"; and (6) "Remarks on Interpretation." The earlier discovery of the great radiation belt around the earth with Satellites 1958 Alpha and Gamma has been confirmed and greatly extended with an apparatus of much greater dynamic range and discrimination. It appears likely that many important geophysical phenomena are intimately related to the reservoir of charged particles found to be trapped in the outer reaches of the earth's magnetic field. Author

N65-11694*# National Aeronautics and Space Administration, Washington, D. C.
SPECTRAL DISTRIBUTION OF DIRECT AND DIFFUSE SOLAR RADIATION [SPEKTRAL'NOYE RASPREDELENIYE PRYAMOY I RASSEYANNOY RADIATSII]
O. Avaste, Kh. Moldau, and K. S. Shifrin Oct. 1964 46 p refs Transl. into ENGLISH from Issled. po Fiz. Atmosfery (Tallinn), v. 3, 1962 p 23–70 Previously announced as N63-23336 24-12
(NASA-TT-F-9142) OTS Prices: HC $2.00/MF $0.50

The results of the calculations of the spectral distribution of direct and scattered solar radiation under various degrees of atmospheric clarity are given with consideration for the absorption of body water vapor, carbon dioxide, and ozone. The calculations for the standard radiation model of the atmosphere coincide quite well with the mean experimental data. An approximation formula is proposed for determining the albedo effect on the descending scattered radiation flux for the cases of real absorption. It also shows that the real observation of the elongation of the atmospheric indicatrix of scattering with the increase in the wavelength directly follows the scheme of K. S. Shifrin and I. N. Minin. Author

N65-11787# Air Force Cambridge Research Labs., Bedford, Mass.
A STUDY OF THE FINE STRUCTURES IN THE SOLAR CHROMOSPHERE Environmental Research Papers No. 49
J. M. Beckers (Ph.D. Thesis—Utrecht U.) Sep. 1964 134 p refs
(AFCRL-64-770; AD-607860)

This is a study of high resolution solar disk spectroheliograms in the light of the hydrogen Hα line (6562.8A) and of the calcium K line (3933.7A). The following subjects were investigated: "Description of the Chromospheric Structure in Hα"; "Properties of the Hα Dark Fine Mottles"; "Spectrum of Spicules on the Solar Disk"; "The Interpretation of the Hydrogen Spectrum of Spicules"; and "Spectroheliograms in Other Lines Than Hα." G.G.

N65-11822# Texas U., Austin Electrical Engineering Research Lab.
THEORETICAL AND EXPERIMENTAL EVALUATION OF AN ENCLOSURE FOR THE INVESTIGATION OF ATMOSPHERIC LONGWAVE RADIATION PHENOMENA Final Report
Glen E. Willis and Claude E. Duchon 30 Jun. 1964 49 p refs
(Contract AF 19(628)-2475)
(EERL-TR-4-11; AFCRL-64-692; AD-607537)

An enclosure was constructed of a polyethylene film top and four polished aluminum walls resting on a platform on the ground. Measurements of longwave radiation and air temperature were made at various locations inside the enclosure as a function of time under clear nighttime skies. A mathematical model has been formulated in which the upward and downward components of radiation have been computed from radiative transfer theory as a function of height at the center of the enclosure. The computations show that with a wall reflectivity of 0.95, a polyethylene film reflectivity of 0.15, and the lower boundary radiating as a blackbody, the divergence of net radiation due only to the walls is the same order of magnitude as the divergence measured in the atmosphere. Values of divergence have been measured inside the real enclosure of the same order of magnitude as predicted by the theory. The concept of a horizontally homogeneous radiating atmosphere, attained if the walls acted as specular reflectors with a reflectivity of unity, could not be realized. Therefore, the local time rate of temperature change could not be equated to the measured two-dimensional divergence of net radiation through the first law of thermodynamics. Author

N65-11864*# Ludwig-Maximilians-Universität, Munich (W. Germany)
EVALUATION OF TIROS III RADIATION DATA
Fritz Möller and Ehrhard Raschke Washington, NASA, Nov. 1964 216 p refs
(Grant NsG-305)
(NASA-CR-112) OTS Prices: HC $3.50/MF $1.25

A method for determining the mean relative humidity of the troposphere and the surface temperature of clouds or of the ground from radiation data of the TIROS III meteorological satellite is discussed. The errors arising from the assumption of model conditions for the atmosphere have been estimated. This method has been tested with radiation data measured during orbit 61 above the Atlantic Ocean. The results are represented in maps. Surface temperatures determined from measured values above cloudless regions are 8° to 9° C lower than the actual surface temperatures. From the geographical distribution of the relative humidity of the troposphere, the large-scale circulation patterns of the atmosphere (ascending air in the inner tropical convergence zone and descending air in the subtropical belts) can be recovered. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-10958# RAND Corp., Santa Monica, Calif.
POSSIBLE GALACTIC SCALE DISCRETIZATION
Dominic G. B. Edelen Nov. 1963 81 p refs
(RM-3941-RC; AD-604852)

A second-order discontinuity analysis of galactic structures is presented that deals directly with images of galaxies in terms of surfaces in an Einstein–Riemann space, without having to assume any particular form for the momentum-energy tensor. This analysis requires only algebraic equations and linear differential systems. A class C of quasi-oblate spheroidal galactic structures is analyzed, with the results pertinent to quasi-spherical structures considered as a special case. Implications of the Einstein theory of general relativity when there are surfaces of jump discontinuity in the momentum-energy tensor are considered, particularly the relations between intrinsic surface geometry and the corresponding jump strengths. The requirement of strong geometric stability is shown to cause the intrinsic geometry of the bounding surface to be generated by an irrotational isometry. The results are confined primarily to the implications of the eigensequence that delineates the geometric configurations and the corresponding discretization effects. As an immediate consequence of the discretized diameters, both the true eccentricity and the angle between the galactic axis and the line-of-sight, can be obtained from the observed eccentricity. M.P.G.

N65-11047# California Inst. of Tech., Pasadena Owens Valley Radio Observatory
COMPONENT SHAPES IN DOUBLE RADIO SOURCES
A. T. Moffet 1964 5 p refs *Its* Observations No. 8
(Contract Nonr-220(19))
(AD-605230)

Cygnus A and several additional double sources were studied with a high-resolution interferometer at 31 cm and at 10 cm. The apparent component separations and the component dimensions are given in seconds, and the shape of the components is discussed. D.E.W

N65-11058*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A SYSTEM OF EQUATIONS FOR OPTIMIZED POWERED FLIGHT TRAJECTORIES
Gary Mc Daniel 17 Sep. 1964 31 p refs
(NASA-TM-X-53130) OTS Prices: HC $2.00/MF $0.50

The equations of motion for a vehicle with thrust, lift, and drag forces, and a newtonian gravitational force are derived in an earth-fixed polar coordinate system. This system of equations forms the differential equations of constraint in the calculus-of-variations formulation of minimizing flight time between two sets of boundary conditions with inequality constraints imposed on the magnitude of the angle-of-attack or the product of the dynamic pressure and the magnitude of the angle-of-attack. The necessary conditions for optimality are given exclusive of derivation. Also, a computational scheme is given suitable for a digital computer program. Author

N65-11061# Douglas Aircraft Co., Inc., Santa Monica, Calif.
MISSILE AND SPACE DIV. LUNAR MISCELLANY
J. A. Ryan Apr. 1963 41 p refs
(SM-43544; AD-420980)

Brief, nontechnical discussions are presented of the following subjects: (1) facets of the lunar surface temperature problem, particularly those that have given rise to some degree of confusion; (2) demonstration of the fact that the radioactivity of the lunar surface materials, either introduced at the time of their formation or produced through the action of the incident radiation, is not a hazard to man; and (3) the present state of knowledge concerning lunar soil mechanics. P.V.E.

N65-11138# Federal Scientific Corp., New York, N.Y.
STAR IDENTIFICATION BY OPTICAL RADIATION ANALYSIS Technical Documentary Report, May 1962–Jan. 1964
Wright-Patterson AFB, Ohio, AF Avionics Lab., Jan. 1964 205 p refs Prepared for Polarad Electronics Corp.
(Contract AF 33(657)-8184)
(AL-TDR-64-13; AD-605409)

The purpose of this investigation is to determine the feasibility of recognizing stars by means of their optical radiation characteristics for use in the guidance and navigation of aerospace vehicles. It is concluded that there are three easily measured independent parameters from the radiation of individual stars which permit unique recognition of the brightest stars above the earth's atmosphere. The following questions are analyzed: (1) What parameters are intrinsic to a star? (2) Which of these intrinsic parameters can be easily measured by radiation analysis? (3) Using the accurate spectral data for bright stars that are reprinted in this report, can recognition be accomplished with the measurable parameters? (4) What is a practical means for accomplishing identification in a tactical situation? Author

N65-11209# Douglas Aircraft Co., Santa Monica, Calif.
INVESTIGATION OF CONTROL DATA REQUIREMENTS FOR SUPER-ORBITAL RE-ENTRY
W. R. Bush and R. G. Seibert Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Aug. 1964 140 p refs
(Contract AF 33(657)-11544)
(FDL-TDR-64-118; AD-606066) OTS: $5.00

The areas covered by this report include a method for computing the impulse optimum approach trajectory to a landing point, given the position and orbit of the space vehicle. Also included is a method of statistically determining the expected impulse required for an approach to the earth with imperfect measuring devices, imperfect thrusting devices, and imperfect knowledge of the initial orbit. This is done where corrections are based on distance to earth, or the size of the required correction. Also included is a statistical method of computing the optimum number and locations of corrections along an approach to enter the earth's atmosphere. The most important results of this study are not the data that are presented, but the methods of study and the tools that have been developed and mechanized to study the planetary approach problem. Author

N65-11274# Lincoln Lab., Mass. Inst. of Tech., Lexington
HAYSTACK POINTING SYSTEM: PLANET Group Report, 1964-46
H. E. Frachtman 10 Sep. 1964 41 p
(Contract AF 19(628)-500)
(ESD-TDR-64-372; AD-606501)

This report describes the procedure used by the Haystack pointing computer program for obtaining the celestial coordinates of the planets at any time. Author

N65-11280# Joint Publications Research Service, Washington, D.C.
RADIOASTRONOMICAL OBSERVATIONS USED FOR DETERMINING POSITION OF REGION WHERE CHARACTERISTICS OF SOLAR ATMOSPHERE CHANGE RAPIDLY
A. P. Molchanov 27 Nov. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 2, 11 Sep. 1964 p 302–304
(JPRS-27564; TT-64-51812) OTS: $1.00

Observations of solar eclipses were made repeatedly, and the results of some of them were used to find the radio radius, r_r of the sun. The difference in the times of contact of the lunar and solar disks, measured by radio and optical methods, is used for this radius calculation. Observations of the second and third contacts were used, since near these contacts the change in the covered area of the solar disk occurs considerably more rapidly, and the accuracy of determination of the photospheric radius r_p is appreciably greater than when the first and fourth contacts are used. Results of the observations and calculations show that there is a characteristic value of the radio radius of the sun that has little dependence on wavelength. It was concluded that with all the wavelengths used, the radio radius remained quite constant, and the ratio r_r/r_p varied from 1.024 to 1.033. D.E.W.

N65-11314# RAND Corp., Santa Monica, Calif.
THE APPLICATION OF DYNAMIC PROGRAMMING TO SATELLITE INTERCEPT AND RENDEZVOUS PROBLEMS
F. T. Smith Aug. 1964 98 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4241-PR; AD-604858)

This memorandum discusses the application of dynamic programing to a terminal guidance process for satellite intercept and rendezvous problems. The mathematical equations describing the guidance process are derived and then simplified by linearizing assumptions in order to reduce the complexity of the computation process. Some typical numerical data are then used to evaluate the effect of these linearizing assumptions on system performance. It is concluded that these linearizing assumptions result in satisfactory system performance within practical tolerances as far as the optimal control system is concerned. However, the linearizing assumptions appear to have an adverse effect on the performance of the filter used to process observational data. Author

N65-11374 Yale U. Observatory, New Haven, Conn.
SUMMARY OF INFORMATION ON THE POSITION OF THE SUPPOSED SUPERNOVA OF 1006
B. G. Marsden [1964] 29 p refs Partially Sponsored by NSF

Ancient records from various astrological sources in Arabic, Latin, Chinese, Korean, and Japanese are assembled, translated, and interpreted in order to find the location in 1006 AD and the corresponding present location of the bright star or possible supernova that appeared about May 1 of that year.

It is concluded that the general position of NGC 5882 is compatible with all of the medieval records of the supernova of 1006. The brightness of this supernova was recorded only for the 3 1/2 months of its appearance, and it seems that it remained essentially constant until shortly before its abrupt disappearance. D.E.W.

N65-11408*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE LUNAR REFLECTIVITY MODEL FOR RANGER BLOCK III ANALYSIS
D. Willingham 2 Nov. 1964 15 p refs
(Contract NAS7-100)
(NASA-CR-59564; JPL-TR-32-664) OTS Prices: HC $1.00/MF $0.50

The methods employed in deriving a revised lunar reflectivity model are described in detail, illustrated by plots showing the data scatter that was encountered. A discussion of the need for the revision to the photometric function developed in 1963 and a comparison of the old and new functions are also included. Author

N65-11443*# Consultants and Designers, Inc., Arlington, Va.
ON THE PRESENCE OF OXYGEN IN THE ATMOSPHERE OF VENUS [O NALICHII KISLORODA v ATMOSFERE VENERY]
V. K. Prokof'yev 17 Nov. 1964 8 p ref Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 31, 1964 p 276–280
(Contract NAS5-3760)
(NASA-TT-F-8992; ST-LPS-10242) OTS Prices: HC $1.00/MF $0.50

Spectra of solar light reflected by Venus at 1Å/mm dispersion in the 6300 Å region (α—oxygen band) have been obtained during the period May–July 1962. With the approach of Venus to the Earth a weak absorption band was detected on the short-wave side of the telluric oxygen band. This band may be due to the presence of a negligible amount of oxygen in the upper atmosphere layers of Venus. Author

N65-11445*# Consultants and Designers, Inc., Arlington, Va.
OPTICAL PROPERTIES OF THE ATMOSPHERE OF PLANET MARS IN THE ULTRAVIOLET SPECTRUM REGION [OB OPTICHESKIKH SVOYSTVAKH ATMOSFERY MARSA V UL'TRAFIOLETOVOM UCHASTKE SPEKTRA]
V. I. Garazha and E. G. Yanovitskiy 19 Nov. 1964 14 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 41, no. 5, 1964 p 942–950
(Contract NAS5-3760)
(NASA-TT-F-8994; ST-LPS-10244) OTS Prices: HC $1.00/MF $0.50

It is shown that during the 1956 opposition, the optical thickness of the atmosphere of Mars in the spectral region λ = 360mμ was considerably greater than the unity. It is assumed that the ultraviolet layer of the atmosphere of Mars consists of a mixture of gas with aerosol particles. It was found that at this mixture's single scattering, the albedo of particles is 0.50. Using the Rocard theory for the interpretation of atmosphere indicatrices, the scattering indicatrix was obtained in the indicated spectral region, and the mean radius of the aerosol particle was found to be $0.9 \cdot 10^{-5}$ cm. It was found that aerosol particles have an albedo of single scattering equal to 0.38 and that the concentration of these particles in the ultraviolet layer is rather high. Author

N65-11476# Aeronautical Chart and Information Center, St. Louis, Mo. Cartography Div.
LUNAR COLOR PHENOMENA
May 1964 15 p refs
(ACIC-TP-2; AD-606412)

Factual recordings of two separate observations of reddish spots near the lunar crater Aristarchus are presented. Included is a record of observations of a violet and purple–blue color form on the west side of Aristarchus at the same time as the other observations. Also given is a brief list of previous observations of color phenomena in the Aristarchus region of the moon. P.V.E.

N65-11525# Manchester U., Macclesfield (Gt. Brit.) Nuffield Radio Astronomy Labs.
THE DETERMINATION OF THE ACCURATE POSITIONS OF RADIO STARS BY THE LUNAR OCCULTATION TECHNIQUE OBSERVATIONS OF GALACTIC AND EXTRA-GALACTIC EMISSION AT 408 MC/S Progress Report, Jan.–Mar. 1964
Conrad H. Slater, C. G. T. Haslam, and M. J. S. Quigley [1964] 15 p refs
(Contract N-62558-3928)
(PR-2; AD-606503)

The occultation of 3C245 was successfully observed at 240 Mc/sec, and the immersion and emersion times gave a position (averaged with a previous observation) of right ascension (epoch 1950.0) $10^h\ 40^m\ 06.4^s \pm 0.2^s$, and declination (epoch 1950.0) +12° 19' 16" ±2". A computer program has been developed that will calculate the celestial longitudes and latitudes of radio sources from their right ascension and declination. Also, a computer program has also been developed that will determine the least squares position of a source from the P, $\Delta\ \sigma\ \Sigma$ reductions furnished from the observed times of immersion and emersion when the source is eclipsed by the moon. Radio astronomical observations (at 408 Mc/sec) were made on galactic and extra-galactic emission over a period of several days. Radio observations of a flare on uv Ceti showed a time displacement between the occurrence of the maximum light and the maximum radio emission on frequencies of 408 and 240 Mc/sec, indicating a drift-type event similar to the solar-drift-type bursts. P.V.E.

N65-11660# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEW ACHIEVEMENTS IN STUDY OF THE COSMOS Selected Articles
9 Mar. 1964 52 p refs Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), v. 33, no. 9, 1963 p 9–16
(FTD-MT-63-256; AD-602594)

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N65-11661# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATIONS OF COSMIC SPACE AND THE UPPER LAYERS OF ATMOSPHERE
A. A. Blagonravov *In its* New Achievements in Study of the Cosmos 9 Mar. 1964 p 1–14 (See N65-11660 02-30)

The important results are presented of investigations carried out with the help of Mars I, some of the Cosmos series of satellites, and geophysical and meteorological rockets. The results are reported of research on radiolocation of Mercury, Venus, and Mars. D.E.W.

N65-11663# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COSMOS AND LIFE
A. A. Imshenetskiy *In its* New Achievements in Study of the Cosmos 9 Mar. 1964 p 28–42 ref (See N65-11660 02-30)

Various aspects of exobiology are discussed, including the chemical bases of life, microbiological analysis of meteorites, the detection of living organisms at great heights and the determination of their distribution, life on other planets and in cosmic space, detection of life in outer space, and the duplication of the extreme conditions of outer space in the laboratory to determine organism survivability. D.E.W.

N65-11757# Harvard Coll. Observatory, Cambridge, Mass.
RESEARCH DIRECTED TOWARD THE OBSERVATION AND INTERPRETATION OF SOLAR PHENOMENA Final Report
Howard L. de Mastus and Donald H. Menzel Oct. 1964 21 p refs
(Contract AF 19(604)-4961)
(AFCRL-64-712; AD-607753)

The flare patrol and other observation and research work under this contract are described. Daily observations are made of coronal emission, monochromatic photographs of prominences around the limb of the sun, and records of all types of detectable activity on the disk of the sun. The observational data are reduced to a quantitative form suitable for analysis, and are reported on a daily basis to various users. Abstracts are given of specialized reports issued under contract sponsorship. R.L.K.

N65-11780# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
ON THE PROBLEM OF PHOTOMETRIC UNIFORMITY OF THE MOON'S SURFACE
N. P. Barabashov, V. A. Yezerskaya, V. I. Yezerskiy, and T. I. Ishutina 9 Oct. 1964 21 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Komis. po Fizike Planyet (Moscow), no. 1, 1959 p 67–79
(RSIC-304; AD-607724)

On the basis of V. A. Fedorets' catalog of reflectivity of the moon's features and by specially measuring of the photographs of the moon, it was established that the moon's surface is characterized by a high degree of photometric uniformity; i.e., on the average, it has uniform porosity. Author

N65-11871*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF A LUNAR LANDING TECHNIQUE FOR LANDING FROM AN ELLIPTIC ORBIT ESTABLISHED BY A HOHMANN TRANSFER
L Keith Barker Washington, NASA, Dec. 1964 24 p refs
(NASA-TN-D-2520) OTS Prices: HC $0.75/MF $0.50

An analytical study was made to determine whether a previously developed technique for performing the lunar landing trajectory can be applied to landings from an elliptic orbit established by a Hohmann transfer. The Hohmann transfer maneuever is initiated from a circular parking orbit 80 international nautical miles above the lunar surface, and the pericynthion altitude of the resulting elliptic orbit is 50 000 international feet. The technique consists of maintaining a constant angle between the thrust vector and the line-of-sight to the command module in a parking orbit. Trajectory computations based on the use of the orbiting vehicles for thrust-vector orientation resulted in efficient landings. The variation of terminal conditions due to errors in thrust direction, thrust magnitude, and initial condition of the lander at initiation of the braking maneuver was examined. Author

N65-11972# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
COLOR CONTRASTS ON THE LUNAR SURFACE
N. P. Barabascheff 21 Sep. 1964 11 p refs Transl. into ENGLISH from Priroda (Moscow), v. 42, no. 12, 1953 p 88–90
(RSIC-271; AD-607722)

Observations of the lunar surface by various astronomers are reviewed for the study of the distribution of colors and the evolution of lunar-surface features. Although rough conclusions can be made from previous studies, it is concluded that quantitative measurements of colors in many areas of the moon are essential for the determination of the intensity of these colors and their comparison with colors of earthly species. D.S.G.

N65-11973# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
DETERMINATION OF THE POLARIZATION OF THE LUNAR AUREOLE
Yu. N. Lipskiy 9 Oct. 1964 23 p refs Transl. into ENGLISH from Tr. Gos. Astron. Inst., Soobshcheniya (USSR), no. 80, 1951 p 3–17
(RSIC-303; AD-607958)

It is said that the aureole surrounding any sufficiently bright heavenly body is a consequence of the diffusion of light in the earth's atmosphere, and that its polarization is not caused by the atmosphere. Repeated studies indicate that lunar light is partially polarized, and that the degree of polarization changes with the lunar phases. Some propositions relating to partially polarized light are discussed, and measurements are reported of the intensities of lunar light analyzed with a polaroid filter oriented in various directions. D.E.W.

N65-12020*# Consultants and Designers, Inc., Arlington, Va.
RADAR LOCATION OF THE SUN [O RADIOLOKATSII SOLNTSA]
V. E. Merkulenko 9 Nov. 1964 12 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 5, 1964 p 825–831
(Contract NAS5-3760)
(NASA-TT-F-8987; ST-SP-RWP-10236) OTS Prices: HC $1.00/MF $0.50

The expression for the energy received from a signal reflected from the corona is derived on the basis of the gaussian distribution of the probability of radio-wave scattering on the inhomogeneities of electron density. The scattering at the point of integral inner reflection is not considered. The possibility of determining the statistical distribution function of inhomogeneities is investigated, taking into account that the signal, reflected from the corona, has a Doppler contour. Author

N65-12063# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EARTH-TO-MOON TRAJECTORIES IN THE RESTRICTED THREE-BODY PROBLEM
P. A. Lagerstrom and J. K. Kevorkian (Calif. Inst. of Tech.) [1963] 60 p refs Submitted for Publication
(Grant AF-AFOSR-62-256)
(Eng. Paper-1646; AD-602538) OTS: $3.00

Motion of a particle of negligible mass from the neighborhood of a gravitational center (the earth) of mass (1μ) to the neighborhood of a second center (the moon) of mass μ is studied within the framework of the restricted three-body problem by asymptotic methods for the case $\mu << 1$. It is shown that there exist two regions centered around the earth and moon respectively, and two associated approximations of the exact equations that to order unity are Keplerian relative to their corresponding centers. The orbit may be divided into three parts: approach orbit to the moon, moon passage, and the orbit after moon passage. The first and third part are dominated by the attraction of the earth, the moon giving a perturbation of order μ to the first-order Keplerian orbits. The

moon passage is to first order a hyperbolic orbit relative to the moon, the earth's attraction being negligible. It is shown that, even to first order, the angular momentum of this orbit depends on the correction to order μ. Author

N65-12112# Royal Aircraft Establishment, Farnborough (Gt. Brit.)
OPTIMUM IMPULSIVE TRANSFERS BETWEEN NON-COPLANAR CIRCULAR ORBITS OF DIFFERENT RADII
H. Hiller London, Min. of Aviation, May 1964 36 p refs
(TN-Space-67)

A study has been made of optimizing the Hohman-type impulsive transfer between inclined circular orbits of different radii. The total characteristic velocity (which is a measure of fuel consumption) is used as the criterion. Two- and three-impulse transfers with a common center of attraction have been considered, together with the same number or fewer associated angular plane changes. For the optimum triple-impluse, triple plane-change transfer, the first and third partial angular plane changes are always small, less than 6°, and often zero. Hence the second plane change is dominant, and so it is not unexpected that the single plane-change transfer (with plane change at the second impulse) is found to be almost as good as the triple plane-change transfer. Author

N65-12113# System Development Corp., Santa Monica, Calif.
NEARLY CIRCULAR PERIODIC ORBITS ABOUT AN OBLATE PLANET
Richard B. Barrar 28 Feb. 1963 13 p refs
(SP-1067/002/00; AD-298712)

The existence of periodic orbits for the motion of a satellite of an oblate planet is shown in the case of vanishing eccentricity. Four particular subcases are examined: polar orbits, zero inclination orbits, critical inclination orbits, and finally orbits at all other inclination angles. Author

N65-12190# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
A COMPARISON OF THE LAW OF LIGHT REFLECTION AS RELATED TO THE MOON AND TO SOME ROCK VARIETIES
N. S. Orlova 9 Oct. 1964 10 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. Ser. Mat., Mekh. i Astron. (Leningrad), no. 1, 1957 p 152–157
(RSIC-301; AD-607959)

This study pertains to the comparisons of indicatrixes of celestial bodies with those of terrestrial materials. A theory is presented that all surfaces having a similar indicatrix under any conditions of illumination will also have a similar photoelectric relief. Indicatrixes of the reflections of the moon's surface were juxtaposed on several indicatrixes for smooth, natural surface fractures of rock specimens, and the light intensities and their relative magnitudes for each rock specimen were plotted in conventional graphs with cartesian coordinates. A close similarity of the scoriae-light indicatrix to the moon's surface indicatrix was observed. G.G.

N65-12254# RAND Corp., Santa Monica, Calif.
PROCEEDINGS OF THE CONFERENCE ON DISCRETE PARAMETERS IN COSMOLOGY (JUNE 29–30, 1964)
Thornton Page, comp. Sep. 1964 25 p refs
(RM-4267-RC; AD-606037)

Theoretical results were presented based on certain restricted solutions to the field equations of general relativity and the assumption of geometric stability. New measures were presented on 200-inch photographs of the angular diameters of 130 elliptical galaxies (types E0, E1, and E2) in eight clusters that tend to confirm the conjectured discretization. Two other statistical tests for evaluating discrete phenomena were proposed. A new catalog of galaxy data, including redshift data for 959 galaxies, and all published data on diameters compiled from the astronomical literature, were described. Observational evidence of discretization in measured redshifts that can be interpreted as an ordered spacing of clusters of galaxies was presented. Evidence for a local supercluster or grouping of nearby clusters of galaxies was summarized. Statistical analysis of counts of galaxies in seven different clusters and the evidence for subclustering were discussed. Author

N65-12295# Royal Aircraft Establishment, Farnborough (Gt. Brit.)
DERIVATIVES AT INJECTION INTO ORBIT AS FUNCTIONS OF ECCENTRIC ANOMALY
R. Law Jul. 1964 37 p refs
(RAE-TM-SPACE-40)

An earlier note treated the effects of injection errors on a satellite orbit by means of first-order partial derivatives; these were expressed as functions of true anomaly. However, it is sometimes more convenient to express them as functions of eccentric anomaly, and they are given here in that form. The first-order partial derivatives of the eccentric and mean anomalies at injection are derived in this paper. Numerical results for these derivatives are for the same family of orbits illustrated in the previous note, and are given in dimensionless form. Conversion to dimensional form, for particular values of the earth constants, is also illustrated. Author

N65-12316*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE THERMAL ENVIRONMENT OF THE TERRESTRIAL PLANETS (SUPPLEMENT 4)
Klaus Schocken 30 Sep. 1964 23 p refs
(NASA-TM-X-53138) OTS Prices: HC $1.00/MF $0.50

An atmosphere of a light gas such as hydrogen for Mercury hardly seems possible. However, since a hydrogen atmosphere is cold, its dissipation occurs slowly, and the loss of hydrogen can be compensated by the interception of solar protons. The amount of water in Venus' atmosphere above its cloud layer is equivalent to a layer of liquid water 98μ deep. The uncertainty amounts to $\pm 5\%$. A secondary source of water vapor in the upper terrestrial atmosphere may be the solar origin of the entire hydrogen content of the Earth's oceans. The protons contained in the solar wind are trapped by the Earth's magnetic field and, after a process of accretion throughout the age of the Earth, are oxidized as water. The law of scattering of light from a dark, intricate surface has been derived theoretically by B. W. Hapke. The success of the model in duplicating the measured lunar photometric data makes it possible to draw conclusions regarding the microstructure of the lunar surface. Author

N65-12328# Air Force Academy, Colo. Frank J. Seiler Research Lab.
MINIMUM FUEL TRAJECTORIES WITH SOFT LANDINGS
Orlando J. Manci, Jr. 30 May 1964 53 p refs
(SRL-64-3; AD-447904)

Minimum fuel trajectories for rocket flights with soft landings in a uniform gravitational field are presented as functions of two parameters. The solutions are valid for any uniform gravitational field, rocket fuel, and burning rate. The problem is formulated as a flight over a flat moon without atmosphere. The solution is subject to the differential constraints of the equations of motion and the end point conditions that require zero velocity at takeoff and landing. This system of equations involving five parameters is reduced to a two-parameter system by means of dimensional analysis. This two-point boundary-value problem is solved on the electronic differential analyzer. The solutions are presented as curves of the initial condition of each Lagrange multiplier, rocket cutoff and reignition times, total flight time, initial thrust angle, and final

mass fraction, all as functions of range. A method for mechanizing this solution suitable for one-man back-pack type, as well as for heavier systems is described. Author

N65-12331# Weapons Research Establishment (Australia)
A LEAST SQUARES FIT OF THE THEORETICAL TRAJECTORY OF A BALLISTIC VEHICLE UNDER FULL GRAVITATIONAL POTENTIAL TO THE DATA OF AN OBSERVED TRAJECTORY
B. D. C. Richards Jul. 1964 42 p refs
(WRE-TN-TRD-14)

This document presents a method for selecting a set of boundary conditions of position and velocity which, on the application of the theoretical equations controlling the motion of a particle in vacuum, produces a trajectory that is the best fit to a set of observed data on position and velocity. The purpose of this note is not strictly to describe a mathematical model, but to indicate how data are applied to the model. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-11001*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOUNDING ROCKET RELIABILITY REASSESSMENT
Abrom Hisler Washington, NASA, Nov. 1964 26 p refs
(NASA-TN-D-2222) OTS Prices: HC $0.75/MF $0.50

The life history of a rocket motor is used to detect failure modes and to increase reliability. A checklist of failure modes is included, which specifies detection techniques and corrective action and gives associated references in the bibliography. A failure-study chart was developed to present a fast rundown on a particular failure, the assumed failure modes, the corrective action taken, and the resulting consequences. R.L.K.

N65-11052*# Illinois U., Urbana Coordinated Science Lab.
AEROSPACE GROUP
H. W. Knoebel et al *In Its* Progr. Rept. for Mar., Apr., and May 1964 20 Jul. 1964 p 1-20 (See N65-11051 02-23) OTS Prices: HC $4.00/MF $0.75

An experiment is described in which the first rocket was fired at Wallops Island, Virginia, in a series of experiments probing the ionosphere. Success is reported for the experiment to measure the differential absorption and Faraday rotation for the determination of electron-collision frequency in the D-region. D.E.W

N65-11147*# Pennsylvania State U., University Park Ionosphere Research Lab.
THE MOTHER-DAUGHTER IONOSPHERIC EXPERIMENT PAYLOAD DESCRIPTION AND PERFORMANCE Scientific Report No. 229(E)
W. Cantrell 1 Oct. 1964 135 p refs
(Contract NAS5-3059; Grant NsG-134-61)
(NASA-CR-59530) OTS Prices: HC $4.00/MF $1.00

The detailed design of a complete rocket payload suitable for measuring electron densities in the F-region of the ionosphere by a separating capsule technique is described. In the experiment a rocket payload is separated into two sections in the ionosphere. Signals are propagated between the two at approximately 6, 12, and 72 Mc/sec and phase measurements made on the received signals. In this way the wavelengths at 6 and 12 Mc/sec and, hence, the electron density in the intervening region can be calculated. Instruments included in the payload allow the separation velocity and payload attitude to be determined. Author

N65-11150# Air Force Systems Command, Eglin AFB, Fla. Air Proving Ground Center
EXOS (AA13.831) VERTICAL PROBE LAUNCHING REPORT, VEHICLE LAUNCHED 25 JULY 1963
Marshall F. Cartledge Sep. 1963 103 p
(AIDR-63-49; AD-451224)

This report presents test vehicle data, launch facilities data, payload and range instrumentation data, and plots and tabulations of vehicle performance. Author

N65-11276# Douglas Aircraft Co., Santa Monica, Calif. Missile and Space Systems Div.
THE REUSABLE BOOSTER FOR LUNAR LOGISTICS AND PLANETARY EXPLORATION
Phil Bono, J. L. Woodworth, and G. A. Ursini [1964] 27 p refs
(Douglas Paper-1887; AD-605209) OTS: $2.00

This is an evaluation of the mission potential of a hypothetical orbital booster as a representative lunar cargo carrier. It is assumed that the orbital booster can be refueled during the earth orbit. A minimum-payload mission is discussed having 500 000 lb of useful payload to be delivered directly to the moon, and 50 000 lb of selenological specimens returned to the earth by the reusable cargo transport. A number of speculative engine-module configurations are presented; the major propulsive problem areas for the mission orbit and return are identified; and the problems related to the buildup of a hypothetical lunar base are developed. It was concluded that a reusable single-stage-to-orbit vehicle, with engine plug-nozzle modifications, can be used in various space applications, and that a hydrogen-cooled entry body nose appears to be technically feasible for the 1986 to 1989 time period. G.G.

N65-11287# Weather Bureau, Washington, D.C.
ON THE USE OF REDUNDANCY IN THE DESIGN OF OPERATIONAL SATELLITES
S. Fred Singer Apr. 1963 11 p
(MSL-17)

An operational analysis is performed on how best to use redundancy of subsystems in order to maximize the operating life of a satellite and thus reduce the annual operating cost. It is important to distinguish two extreme classes of subsystems; according to whether they deteriorate by (A) operation or (B) exposure to space environment. Class (B) items should be eliminated from the design of an operational spacecraft. If this is possible, then optimizing procedures can be stated quite directly. With Class (B) items present, more attention must be given to details, particularly weight tradeoffs. Author

N65-11434# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group
DATA REPORT OF THE METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME IX: FALL 1961 FIRINGS
Sep. 1964 340 p
(IRIG-109-62; AD-451630)

This report contains wind and temperature data collected from Meteorological Rocket Network firings, plus the radiosonde observations nearest the time of firings, when available.

The results of 159 rocket firings made during September, October, and November 1961 are presented. A complete index, with launch sites and data page numbers, is included. D.E.W.

N65-11435# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
DATA REPORT OF THE METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XX: APRIL 1963 FIRINGS
Sep. 1964 201 p
(IRIG-109-62; AD-451631)

This is a meteorological data gathering report from various earth-based rocket ranges and weather stations. All altitudes are reported in meters. Wind and altitude data were obtained from radar plotting grids through a graphical conversion of the sensor displacement during a standard time, and the wind profiles were obtained by the connection of the time-interval computations. Temperature data were obtained with a modified 1680-Mc radiosonde transmitter, recorded with the standard ground detection equipment, and published in raw form. G.G.

N65-11436# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group
DATA REPORT OF THE METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XI: SPRING 1962 FIRINGS
Sep. 1964 292 p
(IRIG-109-62; AD-451632)

This report contains wind and temperature data collected from Meteorological Rocket Network firings, plus the radiosonde observations nearest the time of firings, when available. The results of 136 rocket firings made during March, April, and May 1962 are presented. A complete index, with launch sites and data page numbers, is included. D.E.W.

N65-11635*# General Dynamics/Astronautics, San Diego, Calif.
STUDY OF "RATIO" AUTOMATICALLY ASSEMBLED STRUCTURES Final Report, 15 Jun. 1963–15 Jun. 1964
P. Slysh, G. H. Nowak, J. R. Lloyd, and E. J. Kaminski 1 Jul. 1964 246 p refs
(Contract NAS7-228)
(NASA-CR-59600; GDA-DDG64-017) OTS Prices: HC $6.00/MF $1.50

The RATIO automatically assembled spaceborne structures consist of sectionalized, prefabricated panel members that are nested with respect to each other in a stack having an efficient packaging density. These structures and an equipment for automatically assembling them are described. Preliminary parametric data are developed for the design of RATIO antenna structures. Detailed computer programs are developed for determining the steady-state loads and deflections in the antenna structures. Programs for computing the effects of these deflections on the far-field radiation of the antenna are about half completed. Author

N65-11662# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FLIGHTS OF SHIPS "VOSTOK-5" AND "VOSTOK-6"
V. I. Yazdovskiy *In its* Achievements in Study of the Cosmos 9 Mar. 1964 p 15–27 (See N65-11660 02-30)

Several aspects of the biological effects of weightlessness are discussed in relation to the results of measurements during the flights of Vostok V and Vostok VI. Included are the effects of long weightlessness on spatial orientation, on the functional state of all sense organs, on the cardiovascular system, on the metabolism, on digestive functions, and on discharge functions. Various techniques of measurement are described, as well as date display devices and panels in the capsule. D.E.W.

N65-11679# Atlantic Research Corp., Arcadia, Calif.
SOUNDING ROCKET TEST EVALUATION REPORT SR-001
T. J. O'Donnell 20 Dec. 1962 16 p
(Contract AF 04(694)-220)
(DOC.-02-461-001; AD-447781)

Lift-off occurred at 0.009 seconds after ignition. During first stage burning, the payload nose fairing prematurely separated from the missile. It was determined from post-test analysis of available data that the loss of the nose fairing of the payload caused excessive atmospheric drag on the second stage and payload, and resulted in a subnormal apogee of 150 000 ft. Planned apogee for the flight was 438 000 ft. It was further determined that loss of the nose fairing also prevented the payload from separating from the second stage. Available data indicate that the first stage performed nominally with a burning time of 2.7 seconds. No data were available during the second stage boost period. However, from all indications the second stage performed satisfactorily. Author

N65-11811# Rocket Power, Inc., Mesa, Ariz.
JUDI-ROBIN BALLOON DART SOUNDING VEHICLE Final Report, 3 Jun. 1963–27 Mar. 1964
Clarence W. Watson May 1964 72 p
(Contract AF 19(628)-2805)
(AFCRL-64-471; AD-607074)

The system has been designed to provide a low cost, passive meteorological system to obtain atmospheric density and wind data at altitudes from 100 000 to 215 000 feet. The sensor is a superpressurized mylar ballon, which is one meter in diameter and contains a corner reflector. The balloon is tracked by radar, and the desired information is obtained from the position–time history. Sixteen balloons were ejected from the DART in a vacuum chamber, and 15 flight tests were conducted. Two additional flights were conducted with telemetry aboard to measure the internal temperatures of the DART. The program demonstrated that the balloon could be ejected reliably at the desired altitude. Some difficulties were experienced with the balloon inflation on the first three flights. However, an additional coat of insulating material solved this problem on subsequent flights. The standard ROBIN balloon system was used. Author

N65-11865*# Whittaker Corp., San Diego, Calif.
DEVELOPMENT AND EVALUATION OF THE ELASTIC RECOVERY CONCEPT FOR EXPANDABLE SPACE STRUCTURES
N. O. Brink, B. C. Anderson, C. E. Thompson, and C. E. Wolcott Washington, NASA, Dec. 1964 369 p refs
(Contract NASw-661)
(NASA-CR-121) OTS Prices: HC $5.00/MF $2.00

The purpose of this program was to investigate the feasibility of using elastic recovery for expandable structures. The elastic recovery concept is a mechanism in which the stored potential energy in a packaged structure expands the structure to the original full-sized configuration. The study determined the structural characteristics, thermal insulative characteristics, meteoroid penetration resistance, and radiation protection for the elastic recovery composite materials. The investigation determined the type of elastic recovery composite that could be applied to manned space stations or shelters, storage tanks, antennas, and secondary structures. The results of the study indicate that the elastic recovery expandable compares favorably, on the basis of weight, with other types of expandable structures. Author

N65-11868*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESCRIPTION AND PERFORMANCE OF THREE TRAILBLAZER II REENTRY RESEARCH VEHICLES
Reginald R. Lundstrom, Allen B. Henning, and W. Ray Hook Washington, NASA, Dec. 1964 63 p refs
(NASA-TN-D-1866) OTS Prices: HC $1.75/MF $0.75

A description of the Trailblazer II reentry physics research vehicle capable of reentering a 40-lb payload into the atmosphere at 20 000 ft/sec is presented together with the description and results of three flight tests. The vehicle proved to be a workable system during flight tests by accomplishing the objective of reentering a prescribed payload. The dispersion of the impact points of the various stages was within the expected limits except that the first-stage impact was much closer to the launch point than was originally expected. Approximate wobble motions of the spinning body at various times were determined from telemetered quantities. It was possible to determine the chamber-pressure time history of the third-stage rocket motor and the thrust time history of the fourth-stage rocket motor from the telemetry carried onboard some of the vehicles. The thrust and pressure curves indicated that the thrust was lower during the first part of the thrust period and higher during the latter part of the thrust period than the values expected for a nonspinning motor. Author

N65-12056# Joint Publications Research Service, Washington, D.C.
ACCOUNT OF THE VOSKHOD FLIGHT
V. Komarov et al 1 Dec. 1964 18 p Transl. into ENGLISH from Pravda (Moscow), 6-9 Nov. 1964 p 4, 6
(JPRS-27622; TT-64-51834) OTS: $1.00

A nontechnical, informal narrative of the events before and during the orbital flight of the Voskhod spacecraft is given. D.E.W.

N65-12081*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRELAUNCH ANALYSIS OF HIGH ECCENTRICITY ORBITS
Barbara E. Shute Washington, NASA, Dec. 1964 35 p refs
(NASA-TN-D-2530) OTS Prices: HC $2.00/MF $0.50

This paper surveys the prelaunch analyses of high-eccentricity earth orbits. Pertinent two-body calculations are presented, and computer programs for the perturbations on high-eccentricity earth orbits are reviewed. Graphs of the results of numerical integration are used to illustrate variations in the orbital elements due to the perturbing forces of the earth's atmosphere and oblateness, and to the gravitational fields of the moon and sun. Auxiliary calculations that are useful to the experimenters are discussed. The selection of a launch time to meet experimenters' requirements for the orbital lifetime and spacecraft environment is demonstrated by the construction of a launch window map. Author

N65-12203*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE MICROMETEOROID SATELLITE EXPLORER XIII (1961 CHI)
Charles T. D'Aiutolo, coordinator Washington, NASA, Nov. 1964 204 p refs Collected papers on design and performance
(NASA-TN-D-2468)

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N65-12204*# National Aeronautics and Space Administration. Wahington, D.C.
SPACECRAFT
Charles T. D'Aiutolo *In* NASA, Langley Res. Center Micrometeoroid Satellite Explorer XIII (1961 Chi) Nov. 1964 p 7-28 refs (See N65-12203 02-31) OTS Prices: HC $3.50/MF $1.25

The Micrometeoroid satellite Explorer XIII was the payload of Scout vehicle ST-6, and contained five experiments to obtain information regarding micrometeoroids. These experiments used the following detectors: pressurized cells, steel-covered grids, copper-wire cards, cadmium-sulfide cells, and impact detectors. In addition, a series of temperature measurements were made at selected places throughout the satellite. Voltage measurements were made on test solar cells to measure degradation of the cells. The satellite was cylindrical in shape, about 23 inches in diameter, and about 76 inches long. Arrangement of the spacecraft is shown. It was launched due east from Wallops Island and injected into a near-earth obit. Due to a large injection-angle error, the orbital lifetime was only 2 1/2 days. Tables present the satellite weight breakdown, the sequence of events, comparison of injection conditions, comparison of orbital parameters, and the orbital telemetry history. R.L.K.

N65-12205*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MECHANICAL DESIGN AND INTEGRATION
Hugh C. Halliday *In its* Micrometeoroid Satellite Explorer XIII (1961 Chi) Nov. 1964 p 29-34 (See N65-12203 02-31) OTS Prices: HC $3.50/MF $1.25

Described are design details of the Explorer XIII spacecraft, the variety of surface finishes used, a preliminary fit check, and the balancing and final assembly. R.L.K.

N65-12208*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THERMAL DESIGN
Earl C. Hastings, Jr., Richard E. Turner, and G. Louis Smith *In its* Micrometeoroid Satellite Explorer XIII (1961 Chi) Nov. 1964 p 101-117 refs (See N65-12203 02-31) OTS Prices: HC $3.50/MF $1.25

One phase of the Explorer XIII development was a thermal design study to provide an acceptable temperature environment for the electronic components and the external surfaces of the satellite during ascent and in orbit. It was necessary to establish by preflight analysis and tests that tolerable temperatures could be maintained in three regimes of flight. In the first regime, from launch until release of the heat shield, the satellite was subjected to radiative and conductive heat from the shield. In the second regime, after release of the shield at 350 000 ft, the satellite was heated by free molecular flow. In

the third regime, the orbit phase, it was necessary that temperatures within limits for a 1-year lifetime be established. A study was also made of the effect of elevated rocket-motor temperatures during launch and after burnout. Examination of the temperature data recorded during the lifetime of Explorer XIII . dicated surface temperatures and telemetry temperatures higher than expected, based on calculations for the nominal orbit, but still within the prescribed limits. R.L.K.

N65-12209*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TEST PROGRAM
W. S. Haywood and Hugh C. Halliday *In Its* Micrometeoroid Satellite Explorer XIII (1961 Chi) Nov. 1964 p 119–143 (See N65-12203 02-31) OTS Prices: HC $3.50/MF $1.25

A test program was set up early in the Explorer XIII program to simulate as nearly as possible all expected environmental conditions to which the spacecraft would be subjected during the ascending phase of the trajectory and while in orbit. These tests included spin, acceleration, thermal-vacuum, vibration, and shock. Functional tests were performed on individual modules of the telemeter system. The test procedure started with breadboard construction of telemeter components. Circuits were evaluated in this phase, and components chosen for prototype construction. Prior to the prototype environmental tests, it was found desirable to construct a mockup structure for preliminary evaluation of the spacecraft hardware. Author

N65-12211*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRESSURIZED-CELL EXPERIMENT
Charles A. Gurtler *In Its* Micrometeoroid Satellite Explorer XIII (1961 Chi) Nov. 1964 p 157–166 (See N65-12203 02–31) OTS Prices: HC $3.50/MF $1.25

Pressurized-cell detectors were developed to obtain a direct measurement of the micrometeoroid puncture hazard to thin structural material. A total of 160 detectors were mounted around the periphery of the rocket motor of the Explorer XIII satellite. Material thicknesses of 0.001, 0.0015, 0.002, 0.0025, and 0.005 inch were used on the detectors. The total exposed surface of the detectors was 24.2 $ft.^2$ The pressurized cell detector was designed so that a puncture of the thin test material by a micrometeoroid would allow the pressurized helium to leak out. This pressure loss would create a pressure change across a pressure-sensitive metal-corrugated diaphragm. The deflection of the diaphragm was transmitted to a snap-action switch that was used to signal the puncture to the telemeter. The material used in the thin test section of the detector was beryllium copper. Information telemetered through the 29th pass indicated no switch openings during this time. There was no indication of any malfunctioning of the 160 detectors during launch and orbital life of the vehicle. R.L.K.

N65-12239# Sea-Space Systems, Inc., Torrance, Calif.
SKYHOOK BALLOON RESEARCH Final Report, 24 Feb.–31 Aug. 1964
Dale W. Cox [1964] 9 p
(Contract Nonr-4395(00))
(AD-605301) OTS: $1.00

Flight profiles, flight trajectories, launch and flight descriptions, and postflight analyses are presented for two balloon flights and one tethered launch. The two complete flights took place after difficulties had occurred on the launch pad, and no payloads were carried by either balloon. P.V.E.

N65-12302*# Stanford U., Calif.
ON THE CAPTURE, STABILITY, AND PASSIVE DAMPING OF ARTIFICIAL SATELLITES
Ralph Pringle, Jr. Washington, NASA, Dec. 1964 191 p refs (Grant NsG-133-61)
(NASA-CR-139) OTS Prices: HC $3.00/MF $1.25

This dissertation treats analytically the dynamics of passively damped, gravity-stabilized artificial satellites. Methods are devised to analyze the following phases of satellite evolution: (1) tumbling motions after launch; (2) capture into a bounded libration motion; (3) stability of equilibrium solutions; and (4) damping of the libration motion. These methods are applied to three typical satellite designs of current importance: Vertistat, Beam, and TRAAC. The results of the specific analyses of passively damped satellites show that the methods are capable of handling nonlinear problems of considerable complexity. The methods tend to give much insight into the qualitative behavior of systems; they also provide useful numerical data with only hand computation. Passive damping techniques are evaluated on the basis of the transient response of several specific designs. Certain conclusions about physical structure are drawn from the response formulas. Author

N65-12310*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RADIO FREQUENCY EVALUATION OF SA-6 VEHICLE
Olen Ely, R. W. Hockenberger, Parley Howell, and Geddes Boone 24 Nov. 1964 87 p
(NASA-TM-X-53170) OTS Prices: HC $3.00/MF $0.75

All rf systems performed satisfactorily with the exception of C-band radar, which was approximately 10 to 20 dB below the theoretical values of signal strength. This system suffered an additional 10 dB drop in signal at 480 sec; however, it recovered at 560 sec. Signal strength degradation caused by main engine flame was very similar to that of SA-5. However, unlike SA-5, some of the signal strength data contained noise caused by main engine exhaust until inboard engine cutoff at 143 sec. Retrorocket ignition caused the signal level of all rf systems to drop below threshold. The C-band radar system recovered within 2.4 sec, prior to any other system. The ullage rocket exhaust did not noticeably affect the signal propagation. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-10977# Union Carbide Nuclear Co., Oak Ridge, Tenn.
STRAIN GAGE TEST AT THE THREADED CLOSURE ON A THIRTY-INCH PRESSURE VESSEL
P. J. Long and W. D. Ross 20 Nov. 1964 30 p
(Contract W-7405-ENG-26)
(Y-1471)

Measurements were obtained by utilizing metal-film gages having a gage length of 0.050 in. and a width of 0.044 in. These gages were secured in the root of the threads with Eastman 910 cement. Measuring accessibility was attained using enameled wire of size 34 AWG, spot cemented into the root of the thread. Conventional strain readout instrumentation was used. The highest strains measured were obtained in the thread closest to the internal pressurized area. These values were approximately 3470 μin./in. Author

N65-10991# Army Research Office, Durham, N.C.
MATERIALS FOR ENERGY ABSORPTION AND DISSIPATION
Sudhir Kumar [1964] 26 p refs Presented at the 18th Meeting of the Structures and Materials Panel of AGARD, NATO, Liège, 27 May–2 Jun. 1964
(AD-447614)

A general discussion of energy absorption dissipation and the associated shock and vibration environment is given. The principles and methods of energy absorption through shock isolation, internal hysteresis and structural assembly damping, large elastic–plastic deformations, and acoustic energy are discussed. Energy dissipation through internal hysteresis for structural materials and viscoelastic materials, specific energy damping, material resonance strengths, linear viscoelastic behavior, storage, and loss moduli are presented, along with tables of some of these material constants. Energy absorption by large nonlinear elastic and plastic deformation and the related material properties of stress–strain, maximum acceleration versus static stress, and creep characteristics are discussed. Author

N65-11026# Aircraft Armaments, Inc., Cockeysville, Md.
A PROGRAM TO INDUCE HIGH BLAST-INDUCED AIRLOADS AND STRUCTURAL RESPONSE OF LIFTING SURFACES
R. L. Jarvis, J. J. Kasper, R. R. Mills, and I. O. Wolf Wright-Patterson AFB, Ohio, Flight Dyn. Lab., Jul. 1964 275 p ref
(Contract AF 33(616)-7099)
(ASD-TDR-63-764, Vol. II; AD-605407)

Six experiments were conducted to measure the transient character of the airloads induced by the interaction of blast-generated shock waves on a moving airfoil. The tests were conducted on a rigid (airloads) model of swept planform, similar in type to a B47/B52 aircraft. Airfoil motion was simulated by the shock tube, which produced a jet flow of Mach 0.7. Shock waves were generated by explosive charges that were varied in size and proximity to obtain airloads on the wing that changed both the angle-of-attack and blast duration through a range from small to large. The wing specimens were heavily instrumented with pressure transducers to measure the time history of the variation in the airloads. Response of the wing to the airloads was measured by strain gages and accelerometers. Pressure instrumentation was also used to measure the character of the blast environment. Author

N65-11064# North American Aviation, Inc., Los Angeles, Calif.
ADVANCED X-15A-2 ABLATION SYSTEM DESIGN, TESTS, AND ANALYSIS
Robert H. Johson 14 Feb. 1964 178 p refs
(Contract AF 33(657)-11614)
(NA-64-177)

An investigation of ablation materials was conducted for application to an advanced, Mach 8 modification of the X-15 research airplane. Performance of the selected material, Thermo-Lag T-500, was evaluated in plasma tunnel tests and in flight tests. Estimates were made of required ablator weight and thicknesses at stagnation and nonstagnation areas of the advanced X-15A-2. Performance data, resulting from actual flight tests, plasma tunnel tests, and analytical predictions, were compared. Author

N65-11070# General Dynamics/Astronautics, San Diego, Calif.
CIRCULAR PLATES OF NON-UNIFORM THICKNESS ON AN ELASTIC FOUNDATION
R. D. Mc Ghie and S. N. Dharmarajan 23 Oct. 1964 35 p refs
(GD/A-DDG-64-026)

The differential equation for determining the displacements in a circular plate of nonuniform thickness is derived. A solution to the differential equation is found in the form of a power series. The displacement expression is valid within the framework of small deflection theory. One loading condition is investigated. The answer obtained is of the same relative magnitude as that of flat plate analysis. The plate-thickness variation presented is a function of radial distance from the center; the solution is limited to cases of axisymmetric loading, geometry, and restraint. Author

N65-11151# Watervliet Arsenal, N.Y. Benét R & E Labs.
BOUNDARY LAYERS IN COUPLE-STRESS ELASTICITY AND STIFFENING OF THIN LAYERS IN SHEAR
M. A. Sadowsky, Y. C. Hsu, and M. A. Hussain Oct. 1963 56 p
(WVT-RR-6320; AD-424879)

Couple-stress elasticity theory shows the presence of an elastic boundary layer of minute thickness in which the states of stress and displacement differ essentially and significantly from classical elasticity solutions. The boundary-layer effect becomes dominating for microbodies and microlayers, such as microfibers in composites and brazing layers in welding. Author

N65-11172# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
EXPERIMENTAL DETAILS OF TESTING A FULL-SCALE STRUCTURE WITH RANDOM AND PROGRAMMED FATIGUE LOAD SEQUENCES
A. Nederveen, P. de Rijk, J. Broek, and J. Schijve 31 Jan. 1964 30 p refs Partially sponsored by AF
(NLR-TM-S.608)

For an investigation on the equivalence of random and programed fatigue loads, eight full-scale wing center sections were tested. The present report describes the fatigue machine developed for this purpose and some testing experience. Load monitoring of the hydraulic machine occurs by comparing a feedback signal from a load cell with the output of a selected Wheatstone circuit with an adjustable potentiometer. There are 32 circuits that can be selected by a digital tape reader in any arbitrary sequence. In this way a random sequence of 32 load levels can be applied. The hydraulic and the electronic parts are described in some detail. In eight fatigue tests a good reliability and accuracy were obtained. During the fatigue tests the inspections for cracks were made visually and with X-ray equipment. The results of the X-ray method for small cracks were very sensitive for the mean load in the structure. Author

N65-11204# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile & Space Systems Div.
DYNAMICS TRAINING COURSE LECTURES, VOLUME I
A. A. James, ed. May 1963 238 p
(SM-42981)

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7. GENERALIZED SYSTEMS ANALYSIS R. S. Peterson 6 p refs
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9. BEAM DYNAMICS R. F. Teuber 14 p ref
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13. APPLICATION TO FLUTTER AND CONTROL SYSTEMS T. H. Young 13 p refs

14. GENERALIZED SYSTEMS ANALYSIS B. M. Hall 10 p
15. GENERALIZED SYSTEMS ANALYSES B. T. Mendelsohn 48 p refs

N65-11205# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile & Space Systems Div.
DYNAMICS TRAINING COURSE LECTURES, VOLUME II
A. A. James, ed. May 1963 180 p
(SM-42981)

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6. APPLICATION TO FLUTTER AND CONTROL SYSTEMS T. H. Young 8 p
7. APPLICATION TO FLUTTER AND CONTROL SYSTEMS E. D. Calkin 18 p
8. APPLICATION TO FLUTTER AND CONTROL SYSTEMS B. T. Mendelsohn 37 p
9. APPLICATION TO FLUTTER AND CONTROL SYSTEMS R. F. Teuber 25 p
10. APPLICATION TO FLUTTER AND CONTROL SYSTEMS B. T. Mendelsohn 13 p refs

N65-11245# Boeing Co., Seattle, Wash.
CONTROL SURFACES DEVELOPMENT
E. M. Balog [1963] 322 p refs
(Contract AF 33(657)-7132)
(D2-80082; AD-411271)

This test program was conducted to evaluate corrugated torque-box preliminary design concepts involving strength, stability, and stiffness of truss members and shear webs under static load at elevated temperature. A two-cell torque-box test specimen, 42.0 × 32.5 inches in overall dimensions with flat-top and tapered-bottom René 41 corrugated surfaces, was subjected to simulated environments that included static load only and various combinations of static load in conjunction with uniform and nonuniform temperature conditions. The test specimen satisfactorily sustained all test environmental conditions with no major failure or permanent deformation. Author

N65-11263# Aerojet-General Corp., Azusa, Calif. Von Karman Center
DETERMINATION OF EFFECTS OF MATERIALS AND PROCESS VARIABLES ON FILAMENT-WOUND STRUCTURES Third Quarterly Progress Report, 15 May–15 Aug. 1964
B. E. Chester Sep. 1964 37 p
(Contract N140(131)-75687B(X))
(Rept.-0827-02-3; AD-605572)

Progress of the program during the third quarter, with emphasis on test-specimen refinement, is described. Test results, and fabrication procedures are discussed and supported with illustrations. Projected work and program schedule are included. Author

N65-11322# Utah U., Salt Lake City
CRATERING AND PENETRATION Fifth Quarterly Program Progress Report (Final)
E. P. Palmer, N. P. Bailey, G. H. Turner, C. E. McDermott, S. M. Taylor et al 30 Sep. 1963 118 p refs
(Contract AF 04(694)-259)
(AD-424144)

Techniques and results are summarized for measurements of target heating, target-mass loss, spray energy, and recrystallization and strain energy. The formulation of a general equation describing the relation between pressure, specific volume, and internal energy of a material is reported and compared with existing data. Theoretical and experimental studies of wave motion in an idealized system that can be described by one space variable are summarized. Measurement of subsurface pressure waves, using buried barium–titanate pressure transducers, is summarized, as well as the role of spray particles in impact flash. Correlation of impact parameters with material velocity and with the product of pressure velocity and area is discussed. Two papers, "Energy-Storage Transitions in Materials" and "Penetration Studies by Photographic Techniques," are presented as appendixes. P.V.E.

N65-11335# Mechanical Technology, Inc., Latham, N.Y.
CREEP AND FATIGUE CRITERIA FOR HIGH-TEMPERATURE TURBO-COMPRESSOR LOOP MATERIALS
R. L. Thorkildsen 27 Dec. 1963 187 p refs
(Contract DA-44-009-AMC-316(X))
(MTI-63TM8; AD-601702)

The purpose of this phase of the high-temperature materials project is to develop criteria that describe the creep and fatigue characteristics of structural materials. This has been done by performing a detailed review of the literature, deriving equations and design charts that describe data that are most applicable to loop design, establishing limits for the proper use of these criteria in both materials selection and design evaluation and, whenever possible, by relating complex behavior to the results of simple laboratory tests or to other commonly available test data. Author

N65-11337# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile & Space Systems Div.
STRUCTURAL OPTIMIZATION OF RIB-STIFFENED CYLINDERS SUBJECTED TO EXTERNAL PRESSURE
H. Chao and J. T. Hofeditz 16 Sep. 1963 46 p refs
(SM-44622)

A procedure is given for determining the optimum cross-section dimensions of an infinitely long rib-stiffened cylinder subjected to external pressure. Overall instability, local buckling of the skins and ribs, and failure by exceeding the allowable compressive strength of the material are considered. Discontinuity stresses induced by the ribs are taken into account. Although the material is assumed to be perfectly elastic, a method is outlined for obtaining a first-order approximation for the case of buckling in the inelastic range. Author

N65-11410*# Michigan U., Ann Arbor
AN ASYMPTOTIC SOLUTION TO A PROBLEM IN SHELL STABILITY
Robert L. Armstrong Oct. 1964 94 p refs
(Grant NsG-132)
(NASA-CR-59578) OTS Prices: HC $3.00/MF $0.75

The problem of finding an equilibrium configuration for a buckled cylindrical shell was investigated. Some residual curvature in the field of the buckled state was assumed in order to carry out the analytical solutions. It was found that the amount of the discontinuity in the axial displacement decreases as the buckle becomes flatter. No unique equilibrium load was established, since many buckled configurations are possible for the same external load. Comparison of the experimental

buckled shape with the theoretical shape was found to be complicated by the fact that when buckling has progressed to the point where the valleys and ridges are sharply defined, the shell material will have yielded, and the effects of a nonelastic material will become apparent. G.G.

N65-11456# Pratt and Whitney Aircraft, East Hartford, Conn.
DYNAMIC THERMAL AND PRESSURE STRESSES IN THIN SPHERICAL SHELL Interim Technical Report
H. Kraus 8 Apr. 1964 28 p refs
(Contract DA-31-124-ARO(D)-146)
(PWA-2329; AD-602542) OTS: $2.00

A study was made of the transient response of a nonshallow spherical shell insulated at its inner surface and subjected to a suddenly applied, and subsequently constant, heat flux over its outer surface. The shell is assumed to be closed at its apex and either clamped or simply supported at its edge. Also considered is the transient response of such a shell to step changes of pressure parallel and/or perpendicular to its surface. The primary goal of the investigation is the evaluation of the effect of inertia in transient thermal stress problems involving thin shells. Heretofore, such problems have been handled by means of a quasi-static formulation in which the inertia of the shell was ignored and time entered only as a parameter from the transient temperature distribution. This becomes a special case of the present, more general, solution. Since the determination of the response of the shell to a transient mechanical load is another special case of the analysis, this is also presented. Author

N65-11464# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
SIMILITUDE IN THE TESTING OF SOLID PROPELLANT ROCKET NOZZLES
S. W. Gouse, Jr. Jul. 1964 60 p refs
(AMRA-TR-64-18; AD-606563) OTS: $1.50

The fluid flow, heat transfer, and stress conditions in a hollow cylinder were analyzed, assuming that the results could be at least qualitatively applied to the actual conditions that exist in and near the throat of a solid-propellant rocket nozzle. The possibility of a transition in the hydrodynamic boundary-layer flow from laminar to turbulent was included, and the change in results due to such transitions is shown. Two types of nozzles were considered: (1) a geometrically similar series with a constant ratio of outside to inside radius, and (2) a series with a constant nozzle exit plane wall thickness. Various results such as working stress, temperature drop, heat transfer coefficients, etc., are presented for each series both separately and in comparison. Author

N65-11466# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE CALCULATION OF A THICK-WALLED NONUNIFORM PIPE
M. M. Plotnikov 13 Dec. 1963 11 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro (Moscow), no. 12, 1960 p 104–109
(FTD-MT-63-145; AD-605874)

The flat stress condition in an anisotropic nonuniform pipe, subject to action of internal and external pressures, is considered when the elastic modulus E γ varies by a hyperbolic and exponential law. When E γ varies by hyperbolic law, an asymptotic solution only is obtained, but when E γ varies by exponential law, the solution is obtained in a closed form. Author

N65-11467# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CERTAIN MATHEMATICAL METHODS OF SOLVING ENGINEERING PROBLEMS
I. A. Birger 6 Apr. 1964 175 p refs Transl. into ENGLISH of the book "Nekotoryye Matematicheskie Metody Resheniya Inzhenernykh Zadach" Moscow, Gos. Izd. Oboronnoy Prom., 1956 p 1–151
(FTD-MT-63-190; AD-606757)

Normal fundamental functions and integral equations are applied to engineering problems. Examples refer to problems of strength, stability, and vibrations of elastic systems; however, the results can be used also in other fields of engineering. Author

N65-11469# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING COMBINED LOADING OF A MATERIAL DURING BUCKLING OF SHELLS IN A PLASTIC AREA
G. Teters 11 May 1964 10 p refs Transl. into ENGLISH from Latvijas PSR Zinatnu Akad. Vestis (Riga), no. 5, (190), 1963 p 45–50
(FTD-MT-63-267; AD-605885)

The stability of thin shells beyond the limits of elasticity in areas of pure plastic flows is considered. The theory of locality of deformation, which in principle solves the problem of combined loading, was used for the approximation of the actual work of a material in a shell upon loss of stability in the plastic area. An expression was obtained of critical stress for a long, circular, cylindrical shell compressed along generatrices, resulting in an axially symmetric form of buckling. The theoretical dependences of the deformation of the material were compared with experimental data and were found to be well coordinated with the theoretical curves. G.G.

N65-11485# Purdue U., Lafayette, Ind. School of Aeronautical and Engineering Sciences
ON THE THERMOMECHANICAL ANALYSIS AND BEHAVIOR OF VISCOELASTIC MEDIA SUBJECTED TO CYCLIC LOADING
R. A. Schapery Jan. 1964 58 p refs
(Contract AF 94(611)-8539)
(A&ES-64-3; AD-605712)

The interaction between heating and dynamic response of viscoelastic bodies with temperature-dependent properties is studied. Equations governing the thermomechanical response to sinusoidal loading are developed and shown to be equivalent to a set of two variational principles. Viscoelastic properties of a solid propellant are characterized and then used in numerical examples dealing with sinusoidal shear loading of slabs and cylinders. As the first problem, an approximate variational method is used to calculate one-dimensional transient and steady-state temperature distributions in a massless slab. An exact steady-state solution is obtained for the thermomechanical behavior of a slab with concentrated mass, and is then used to deduce the solution for a similarly loaded cylinder. Finally, the influence of distributed mass in a slab and cylinder is studied using variational principles. Author

N65-11513# Stanford Research Inst., Menlo Park, Calif. Material Sciences Div.
EVALUATION OF THERMAL SHOCK RESISTANCE IN POTENTIAL RADOME MATERIALS Progress Report, 1 May–1 Sep. 1964
D. A. Brown 1 Sep. 1964 13 p ref
(Contract Nonr-4213(00)(X))
(PR-3; AD-606671)

Comparison of cracking characteristics as functions of heat flux was completed for unnotched ring specimens of 3/8- and 3/16-inch wall thicknesses of the five materials studied (alumina, magnesium oxide, porcelain, Pyrex, and Pyroceram). A distinct relative rating of the ability of each material to withstand thermal shock and thermal stresses was obtained. The

results also permitted a differentiation between the relative thermal shock–stress resistance of the two wall thicknesses investigated. D.E.W.

N65-11608# Stanford U., Calif.
AN ANALYSIS OF CREEP RUPTURE
Robert L. Carlson Feb. 1964 19 p refs
(Contract Nonr-225(47))
(SUDAER-183; AD-606081)

Ductile creep rupture is considered, and an analysis is made of a work-hardening plastic material that is subject to creep. Under a constant tensile load, the true stress acting on a creep specimen increases, and the rate of work-hardening decreases. Tensile instability develops when the rate of work hardening becomes equal to the true stress. Both tensile instability and creep rupture, and compressive instability and column creep buckling are controlled by the current state of work hardening. Author

N65-11616# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF CONDITIONS OF SERVICE OF UNDERGROUND PIPE LINES DURING EARTHQUAKES
T. Rashidov 26 Dec. 1963 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Tekhn. Nauk (Tashkent), no. 5, 1962 p 44–52
(FTD-MT-63-130; AD-606761)

The basic dynamic theory of the earthquake resistance of a hydroelastic system is considered in the development of differential equations for the oscillation of an underground pipe during earthquakes. It was found that the stress is symmetric, in relation to the middle of the pipeline, and will attain maximum value in the places of connection with other underground systems or at sharp turns of the pipeline. G.G.

N65-11639# Michigan U., Ann Arbor Coll. of Engineering
EFFECT OF 12,000-HOUR CREEP EXPOSURE ON STRUCTURAL SHEET MATERIALS Seventh Progress Report
T. M. Cullen and J. W. Freeman Jun. 1964 8 p
(Contract AF 33(616)-8334)
(Rept.-04583-35-P; AD-606079)

The AM 350 sheet steel in the SCT condition and in the CRT condition is being exposed at 550° F at 67 000 psi to evaluate the effects of exposure time on mechanical properties. The data obtained are to be used in the evaluation of alloys for the supersonic transport. Exposures for 12 000 hr and less have been completed, and results to date indicate the following: (1) The strength properties of both CRT and SCT material have not been significantly changed by stressed or unstressed exposure up to 12 000 hr, and a 2% increase in strength was noted after 12 000 hr. (2) No appreciable change in elongation of notched specimens was noted up to 12 000 hr, and there was only a very slight increase after 12 000 hr. (3) Accelerated equivalent time exposures at 600°, 650°, and 700° F caused no changes in strength properties or elongation. (4) Yield strength and hardness tests also showed little change in either property. (5) Creep measurements indicate that little strain has occurred. M.P.G.

N65-11654# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BEHAVIOR OF STEEL DURING PULSATING LOADING BEYOND THE LIMIT OF FLUIDITY
T. Sh. Chernis 23 Dec. 1963 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk Kazah. SSR, Ser. Mat. i Mekh., (Alma-Ata), no. 10, 1962 p 78–105
(FTD-MT-63-157; AD-606257)

An investigation of the influence of cyclical loading on the characteristics of deformed metals led to the following conclusions: (1) Pulsating loading significantly increases the deformability of materials. (2) A pulsating load significantly lowers the forces necessary for deformation of materials. (3) Frequency has an influence on the magnitude of deformability of steel; (4) Deformability of steel depends both on the composition of the material and on its original structure. (5) The technology involved in cyclic loading is significantly more complicated than during static and fatigue tests; therefore, new methodologies, equipment, and apparatus are needed. P.V.E.

N65-11752# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
REPRESENTATIVE CURVES OF THE LAWS OF LONGITUDINAL AND TRANSVERSE IMPACT ON A PRISMATIC BAR
Saint-Venant and M. Flamant Oct. 1964 35 p ref Transl. into ENGLISH from J. de L'Ecole Polytech. (France), v. 59 1889 p 97–128
(RSIC-300; AD-607957)

This paper develops and presents graphically the Saint-Venant curves of the laws of longitudinal and transverse impact on a prismatic bar that is struck at its end or its center by a body having a mass comparable to its own. It is assumed, in either case, that all points of the same transverse section of the bar undergo the same displacement, or that the transverse sections remain plane. G.G.

N65-11768# North Carolina State Coll., Raleigh
A DIFFRACTION GRATING METHOD FOR MEASURING ELASTIC-PLASTIC SURFACE STRAINS IN METAL SHEETS Final Technical Report, 1 Mar.–31 Jan. 1964
R. A. Douglas, C. Akkoc, and C. E. Pugh May 1964 84 p refs
(Contract Nonr-3799(01)(X))
(NRL-TM-252; AD-607610)

A procedure is developed for making strain measurements from small, separate, plane diffraction gratings ruled as integral parts of the surfaces of flat-metal specimens. A method is devised and implemented to instrument sheet metal specimens with diffraction grating gages ruled directly onto their surfaces. Choice of a particular diffraction-strain relationship, and the use of master gratings in conjunction with diffraction gratings to be used as strain gages, permits use of simple optical instrumentation. Strain measurement resolution and deviation from that of other techniques are examined. The optical diffraction in the form employed permits resolving strain increments of magnitude 0.0008 in the range 0.0003 to 0.030. Strain measurements are recorded and analyzed from Maraging steel specimens containing centrally located notches subjected to axial tension. From test results a strain field in agreement with the elastic theory is evidenced outside a 0.4-inch station from the notch edge. High-strain gradients exist within a 0.1-inch zone surrounding the notch edge with a plastic zone size estimated to be of 0.062 inch as compared to a 0.038-inch plastic zone predicted from standard fracture toughness measurements. An average 16% variation was observed between fracture strengths of specimens loaded parallel and normal to the rolling direction. Author

N65-11813# Oklahoma U. Research Inst., Norman
RESEARCH IN THE FIELD OF FIBERGLASS-REINFORCED SANDWICH STRUCTURE FOR AIRFRAME USE Final Report, 10 Jun. 1963–29 Feb. 1964
Joseph V. Noyes, W. C. Crisman et al Ft. Eustis, Va., Army Transportation Res. Command, Jul. 1964 106 p refs
(Contract DA-44-177-AMC-98(T))
(TRECOM-TR-64-37; AD-607339)

The program encompassed the two types of sandwich fabrication used industrially, the one-step process method and the method whereby prelaminated facings are bonded to the core

in a separate step. The materials chosen for study were Volan A finished 181 fiberglass fabric and EPON 828 epoxy resin activated by curing agent Z. Thin, 3-ply facings of these materials used in conjunction with honeycomb cores were the basic elements of the structural sandwich. The results of the research program include the isolation of the optimum conditions of fabrication, the expected strength values for these optimum fabrication conditions, the best lay-up method, and the performance of several adhesive system–core material combinations with optimum conditions of cure for each. Author

N65-11821# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
EXPERIMENTAL DETERMINATION OF INTERNAL STRESSES IN SOLIDS
Augustin Mesnager 9 Oct. 1964 83 p refs Transl. into ENGLISH from Mem. Sci. Phys. (Paris), no. 10, 1929 p 1–82
(RSIC-299; AD-607723)

An experimental method is presented for the determination of real tensions within a solid that is subjected to stresses. In this method the mathematical difficulties encountered in problems of elasticity are avoided. The concepts of elasticity and problems related to internal equilibrium of elastic bodies and to double refraction are reviewed. The following are discussed: (1) "Isostatic and Isochromatic Lines"; (2) "Values of the Principal Tensions"; (3) "Fundamentals of Strength of Materials"; and (4) "Solutions of Various Problems." D.S.G.

N65-11839# Emerson and Cuming, Inc., Canton, Mass.
DESIGN TECHNIQUES FOR SECTIONALIZED, STRUCTURALLY SUPPORTED AIRBORNE CERAMIC RADOMES Progress Report
Eino J. Luoma, Russell Stetson, and Samuel J. Mason (MIT) *In* Ohio State U. Res. Found. Proc. of the OSU-RTD Symp. on Electromagnetic Windows, 2–4 Jun. 1964, Vol. II [1964] 26 p ref (See N65-11832 02-07)
(Contract AF 33(615)-1376)

This paper discusses suitable structural designs for airborne ceramic radomes in order to overcome their low flexural strength and their brittleness and susceptibility to fractures from thermal stress. The all-dielectric, radome wall design data computation is employed to find the theoretical values for the electrical design, and a set of computerized pressure and thermal tables is planned for the readout of the basic data. G.G.

N65-11902*# Syracuse U. Research Inst., N.Y.
PLANE-STRESS ANALYSIS OF AN EDGE-STIFFENED RECTANGULAR PLATE SUBJECTED TO LOADS AND TEMPERATURE GRADIENTS
Charles Libove, Dalpat Parchal, and Frank Dunn Washington, NASA, Dec. 1964 48 p refs
(Grant NsG-385)
(NASA-TN-D-2505) OTS Prices: HC $1.25/MF $0.50

A plane-stress analysis is presented for an isotropic or orthotropic elastic rectangular plate bounded by four edge stiffeners and subjected to prescribed temperature distributions and boundary loads. The stiffeners are assumed to have zero bending stiffness but finite extensional stiffness. They may be either uniform or tapered in such a way as to develop a constant (or nonconstant but prescribed) cross-sectional stress. In the latter case the required form of taper is determined along with the stress. The solution is by means of Fourier series. Its convergence and feasibility are tested by means of two numerical examples, one a thermal-stress problem and the other a shear-lag problem. Author

N65-11925# David Taylor Model Basin, Washington, D.C. Structural Mechanics Lab.
TESTS OF MACHINED HIGH-STRENGTH STEEL SPHERICAL SHELLS SUBJECTED TO EXTERNAL HYDROSTATIC PRESSURE
Albert E. Dadley Aug. 1964 23 p refs
(DTMB-1854; AD-605375)

Six structural models, consisting of hemispherical shells bounded by ring-stiffened cylinders designed to provide ideal boundary conditions, were hydrostatically pressure-tested to collapse. The models were accurately machined from high-strength steel (STS) and were designed to investigate both elastic and inelastic buckling modes of collapse. The results of the tests are compared with theory, and the collapse pressures agree within ±7% of those computed by the empirical buckling equation. A nondimensional plot of experimental results is presented for the models tested. Based on the plot, a simple design method is given for similar, accurately machined, thin, spherical shells. Author

N65-11965# Ohio State U. Research Foundation, Columbus
LIFE ESTIMATE OF FATIGUE SENSITIVE STRUCTURES Technical Documentary Report, Jul. 1, 1963–Jul. 31, 1964
A. M. Freudenthal Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 13 p refs
(Contract AF 33(657)-8741)
(ML-TDR-64-300; AD-608073)

By defining fatigue failure as an "ultimate load failure" of a structure damaged in fatigue by operational loads, the estimate of fatigue life can be reduced to that of a "mean return period" of an ultimate load type of failure for which statistical methods of safety analysis have already been developed. By applying such methods in conjunction with a simple fatigue damage function, the fatigue sensitivity of a structure can be evaluated in terms of the ratio of the return periods of fatigue failure and ultimate load failure. Author

N65-11974# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
CONTRIBUTION TO THE STUDY OF THE ELASTIC DEFORMATION OF SOLIDS
A. Mesnager 9 Oct. 1964 62 p Transl. into ENGLISH from Anns. Ponts Chauss. (Paris), 1901 p 129–190
(RSIC-305; AD-607734)

The theory of elasticity is developed from the theorems relating to the internal equilibrium of bodies, and from the principle of the independence of the effects of forces. Also described is a method to measure the internal stresses in glass by an apparatus utilizing light rays in a polarization process. It was found that the formulas of two-dimensional tensions are independent of the coefficients of elasticity, and so permit their application to all other bodies. G.G.

N65-11995# Battelle Memorial Inst., Columbus, Ohio
LATERAL VIBRATIONS IN MISSILES: A BIBLIOGRAPHY
L. E. Hurlbert, W. L. Belton, and T. J. Atterbury Huntsville, Ala., Army Missile Command, Jul. 1964 51 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-266; AD-451321)

This bibliography consists of 377 entries and contains the results of a title survey conducted to obtain literature related to the problem of damping the transverse vibration of large missiles. The titles are grouped into three categories covering free vibrations, damped vibrations, and material damping properties. Only papers published in English after 1940 are included. Author

N65-12005# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
COMBINED STRESS PROPERTIES FOR ACRYLIC TUBE SPECIMENS
R. E. Ely 31 Aug. 1964 37 p refs
(RR-TR-64-15; AD-450662)

Biaxial stress and strain data are given for acrylic tube specimens tested at room temperature. The biaxial loading was applied to the tubes by means of internal fluid pressure and axial loads. The initial effective strain rate for all tests was of equal magnitude. Stress data are compared with theoretical criteria, both for small amounts of effective strain and for ultimate load conditions. The effect of test specimen configuration on the ultimate properties was examined briefly. Author

N65-12029# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
AXISYMMETRIC BUCKLING OF THIN PRESSURIZED CYLINDRICAL SHELLS UNDER AXIAL COMPRESSION
Jerome J. Connor, Jr. and John Campo Jul. 1964 60 p refs
(AMRA-TR-64-08; AD-608232) OTS: $1.00

A theoretical and experimental investigation of buckling characteristics of thin pressurized cylindrical shells under axial compression is presented. Theoretical analyses (restricted to the case of small-finite displacements) of axisymmetric elastic, as well as of plastic buckling are included. General dimensionless expressions for radial displacement, principal shear stress, and unit end shortening are determined. In addition, a general relationship is established between plastic buckling load and several parameters, including that of internal pressure. For a given cylinder the experimental results indicate that increasing the internal pressure increases the buckling load as long as the buckling remains elastic. For plastic buckling, on the other hand, both the theoretical and experimental results show that increasing the internal pressure decreases the buckling load. Author

N65-12030# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
FRACTURE TOUGHNESS OF D6AC STEEL SHILLELAGH ROCKET MOTOR CASE
Robert N. Katz Jul. 1964 19 p refs
(AMRA-TR-64-19; AD-606564) OTS: $0.50

Burst tests and fracture toughness measurements on D6AC Shillelagh missile motor cases were carried out. The burst testing was done over a temperature range from room temperature down to −200° F. Results of these tests showed that the motor cases burst at approximately 250 000 psi hoop stress regardless of test temperature and that all fractures were 100% shear. Fracture-toughness measurements were made on cases containing machined and fatigue-cracked through-the-thickness notches, at room temperature and −65° F. The results of these measurements were in good agreement with previously obtained flat sheet data on similar materials. Author

N65-12064# Martin Co., Denver, Colo. Aerospace Div.
EFFECT OF INITIAL IMPERFECTIONS ON THE STABILITY OF SHALLOW SPHERICAL SHELLS Final Report
Gaylen A. Thurston and Francis A. Penning 31 Aug. 1964 125 p refs
(Contract AF 49(638)-1316)
(CR-64-28; AD-448454)

The effect was studied of initial imperfections in shape on the elastic buckling of clamped spherical caps under external pressure. Aluminum specimens were produced by an explosive-forming process. Initial imperfections in the form of an inward dimple at the apex were impressed in the specimens; the amplitude of the dimple ranged from the thickness of the shells downward to zero. The imperfections were made axisymmetric in order to simplify analysis. Theoretical and experimental results were compared for buckling pressures, deflections, and strains. The agreement was good for certain ranges of the parameters, with discrepancies appearing for extremely thin shells and near-perfect shells. D.S.G.

N65-12088*# National Aeronautics and Space Administration, Washington, D.C.
STRESS CONCENTRATION IN A CYLINDRICAL SHELL WITH A ROUND APERTURE IN ITS SIDE [KONTSENTRATSIYA NAPRUZHEN' v TSILINDRICHNIY OBOLONTSI Z KRUGOVIM VIRIZOM NA BOKOVIY POVERKHNI]
Yu. A. Shevlyakov Dec. 1964 6 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 2, 1955 p 123–125
(NASA-TT-F-282) OTS Prices: HC $0.50/MF $0.50

This study deals with the problem of tension in a cylindrical shell with a round opening in its side, reinforced by a rigid ring around the edge. The system of partial solutions of equilibrium equations for a cylindrical shell, as proposed by A. I. Lur'ye, is used in this investigation. Given a uniform internal pressure, the tension along the welded seam between the shell and the ring can be defined by formulas. Author

N65-12104# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
INDENTER METHOD FOR DETERMINING LOCKED-IN TENSILE STRESS
Rolland G. Sturm Nov. 1964 38 p
(R-123)

A simple, quick, and feasible method of detecting the presence of locked-in stresses in members with limited access is presented. The test consists of making an indentation in the metal surface and photographing the indentation at close range. Dimensions of the indentation reveal the locked-in stress when loads are not applied or the total stress upon application of load. Actual observations on the hold-down arms for SATURN S-IC are given as an illustration. Author

N65-12124# Aerojet-General Corp., Sacramento, Calif.
HYDROSTATIC TEST PROCEDURES, TASK II Final Report
T. O'Callaghan, D. E. Sanders, C. S. Lockmen, J. H. Ramsthaler, R. K. Steel et al 31 Jul. 1964 30 p refs
(Contract NOw-63-0627-c(FBM))
(Rept.-0627-II-F; AD-604104)

This report describes the results of an investigation conducted to determine the effect of various hydrostatic-test parameters on the structural integrity of glass-filament-wound chambers. The results obtained in hydrostatic tests of continous-filament spheroids, cut-filament spheroids, and 4-in.-diam chambers designed to fail in the hoop windings, are presented. The spheroids were burst either on the first cycle at one of three pressurization rates or on the second cycle after exposure to various environmental conditions. The 4-in.-diam chambers were divided in three lots, pressurized at one of three pressurization rates, and burst on the first cycle. The effect of these various hydrostatic-test parameters on burst pressure was evaluated. Author

N65-12143# Massachusetts Inst. of Tech., Cambridge Aeroelastic and Structures Research Lab.
THE FLUTTER OF VERY LOW ASPECT RATIO PANELS
Earl H. Dowell Jul. 1964 93 p refs
(Grant AF-AFOSR-62-363)
(AFOSR-64-1723; ASRL-112-2; AD-608702)

The aeroelastic stability of an infinitely long panel of finite width with the upper surface exposed to an inviscid flow is

examined. The panel behavior is accounted for by small-deflection plate theory, whereas the aerodynamic forces acting on the panel are described by the classical linearized, potential theory. The panel is assumed to be simply supported along the side edges, although other edge conditions may be considered in a similar manner (e.g., clamped edges). Rather extensive numerical results have been obtained for flutter velocity (and dynamic pressure) indicating the effects of Mach number, air–panel mass ratio, and viscous structural damping. Author

N65-12145# Stanford U., Calif.
AUTOMATED DERIVATION AND INTEGER REPRESENTATION OF TOTAL POTENTIAL AND DIFFERENTIAL EQUATION EXPANSIONS FOR ASSUMED TRIGONOMETRIC SERIES WITH AN APPLICATION TO THE POST-BUCKLING BEHAVIOR OF CIRCULAR CYLINDRICAL SHELLS
W. A. Madsen, L. B. Smith, and N. J. Hoff Jul. 1964 64 p refs
(Contract AF 49(638)-1276)
(SUDAER-201; AFOSR-64-1726; AD-608205)

Many problems in applied mechanics defy exact solution because of the nonlinear nature of the descriptive differential equations. In such cases, a solution is often obtained through assumption of appropriate trigonometric or power series, and through expansion and collection of coefficients of like trigonometric terms or powers of the variable. The resulting set of nonlinear algebraic equations is then used to obtain the solution. Algorithms are presented for deriving these equations with the aid of a digital computer. The equations are then stored by means of an integer representation. A Newton–Raphson algorithm for solving the integer-form equations is also presented. The method is illustrated by rederiving the solution for the postbuckling behavior of thin-walled circular cylindrical shells under axial compression. Author

N65-12147# Columbia U., New York, N. Y.
FINITE DEFLECTIONS OF VISCOELASTIC CANTILEVERS Technical Report No. 18
M. A. Schoenberg and H. H. Bleich Jul. 1964 19 p refs
(Contract Nonr-266(34))
(CU-1-64; ONR-266(34)-CE; AD-605292)

In a recent paper, the problem of large deflections of a viscoelastic, inextensible cantilever was treated by formulation of integral equations for the elastic case and the viscoelastic case of a cantilever carrying a transverse load at the tip. The behavior of the viscoelastic material was defined by a creep-compliance function, and the integral solutions were solved by an iteration procedure. In this paper the problem is reconsidered; the formulation is presented in the form of partial differential equations and is solved by a standard finite difference approach. This alternative does not give difficulties in the numerical solution and can easily be generalized for statistically indeterminate cases. The numerical results agree satisfactorily with those of the previous paper. D.S.G.

N65-12161# IIT Research Inst., Chicago, Ill.
UTILIZATION OF REFRACTORY NONMETALLIC MATERIALS IN FUTURE AEROSPACE VEHICLES. PART I: REVIEW OF STRUCTURAL DESIGN TECHNIQUES FOR BRITTLE COMPONENTS UNDER STATIC LOADS Technical Documentary Report, Feb.–May 1963
Ralph L. Barnett Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1964 132 p refs
(Contract AF 33(657)-8339)
(FDL-TDR-64-123, Pt. 1; AD-607977)

A systematic review of structural design techniques for brittle materials is presented with particular emphasis on statistical fracture theories. The properties of both series and parallel statistical models are discussed, and a critical analysis is given for the experimental data that are available in the literature. The relationship of extreme value statistics to the fracture problem is thoroughly exploited. A survey of brittle test specimens and of design rules-of-thumb is included, together with a number of very promising design philosophies. Author

N65-12168# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
AN ASSESSMENT OF THE EFFECTIVENESS OF A VISCOELASTIC DAMPER ON THE FORCED VIBRATIONS OF A STRETCHED STRING Technical Documentary Report, Aug.–Sep. 1964
D. I. G. Jones Oct. 1964 14 p refs
(MLTDR-64-322; AD-608383)

The behavior of a dynamic damper in a simple structural environment is studied. The structural model used is a stretched string under harmonic loading at the ends. The aim of the analysis is to establish conditions under which maximum damping is obtainable. The unsymmetrical modes are undamped, and the analysis is concerned only with the damping of the symmetrical modes. Author

N65-12177# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
FATIGUE LOADS APPLIED ON A FULL-SCALE STRUCTURE IN RANDOM AND PROGRAMMED SEQUENCES
J. Schijve Apr. 1964 31 p refs
(Contract AF 61(052)-439)
(NLR-TM-S.609)

For an investigation on the equivalence of random and programed fatigue loads eight full-scale wing center sections were tested. The report describes the load sequences applied in the tests. The random sequence was derived from a strain-gage record obtained with an aircraft flying in turbulent air. This record was amplified and adapted to the fatigue machine. The statistical properties as obtained by several methods, counting peak loads or load ranges, are presented. The load sequence for the program tests and the assessment of the ground-to-air cycles are described. The loads applied in each of the eight tests are summarized. Brief comments on the results are given. Author

N65-12225# J. G. Engineering Research Associates, Baltimore, Md.
POST FAILURE DEFLECTIONS OF CYLINDRICAL SHELLS UNDER DYNAMIC LATERAL LOADS
Joshua E. Greenspon Aug. 1964 13 p refs
(Contract DA-36-034-ORD-3081X)
(TR-5; AD-607746)

The general work-energy approach for calculating plastic deformations is treated. Curves are presented for energy absorbed by cylindrical shells as a function of postfailure deflection for both collapse and buckling failure. A set of curves is also given for predicting whether a shell will collapse or buckle first. Author

N65-12240# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
FATIGUE LIVES OBTAINED IN RANDOM AND PROGRAM TESTS ON FULL-SCALE WING CENTER SECTIONS
J. Schijve and P. de Rijk 15 Dec. 1963 49 p refs
(NLR-TM-S.611)

Fatigue tests were conducted on eight full-scale wing center sections of the F-27 Friendship aircraft. The specimen consisted of the tension skin, including all stiffening elements. The remainder of the wing was replaced by a dummy structure. Two

tests were carried out for each of the following load sequences: (1) random load; (2) programed load; (3) random load with ground-to-air cycles; (4) programed load including ground-to-air cycles. The random loading was based on a simulation of strain gage records obtained by flying in turbulent air. The primary aim of the investigation was to study the equivalence of random and programed loadings. A comparison of the fatigue lives and the critical components indicated the following trends: (1) cracks were found in the same components for all tests. (2) The fatigue life under the programed load was slightly longer than in the random load tests, both for tests without and with ground-to-air cycles. (3) The addition of ground-to-air cycles reduced the fatigue life to 50% or even less. Author

N65-12249# Columbia U., New York, N.Y.
ON UPPER AND LOWER BOUNDS OF THE PROBABILITY OF FAILURE OF SIMPLE STRUCTURES UNDER RANDOM EXCITATION
M. Shinozuka Dec. 1963 30 p refs
(TR-01; AD-602528) OTS: $2.00

Upper and lower bounds are given for the probability $P_x(T; -\lambda_1, \lambda_2)$ $(\lambda_1, \lambda_2 > 0)$ that a separable process x(t) crosses barriers at $-\lambda_1$ and λ_2 in the interval (0, T) under zero initial condition x(0) = 0. The displacement of a damped oscillator with one degree of freedom due to a nonstationary gaussian random input is investigated as an illustration of an analysis that does not require the input to be white noise. If failure of the system is assumed to occur when the absolute value of the displacement exceeds a critical value λ, then $P_x(\infty; -\lambda, \lambda)$ is the probability of failure of the system. Under certain conditions, approximations for lower and upper bounds of $P_x(\infty; -\lambda, \lambda)$ are numerically evaluated with the aid of an electronic digital computer. Author

N65-12283# Boeing Co., Seattle, Wash.
ORTHOTROPIC PANEL FLUTTER ANALYSIS CORRELATION
C. T. Golden, T. R. Hager, and L. L. Sherman [1964] 113 p refs
(Contract AF 33(615)-1785)
(D2-81301; AD-446584)

This document presents the analytical methods developed during the X-20 program for the prediction of panel flutter of rectangular orthotropic panels subjected to supersonic flow over one surface. The modal analysis approach is used in developing the equations of motion. For complex structures, the analytical determination of the stiffness characteristics is not adequate to give accurate results. However, this deficiency is corrected by using experimental shake-test frequencies to formulate the stiffness matrix. Both methods are presented. Examples of two-mode, three-mode, and multimode analyses are given, and the results are compared with wind-tunnel test results. The results of an analysis using three-dimensional aerodynamic surface theory are compared with one using piston theory aerodynamics. Comparisons of analytical and wind-tunnel test results are given for several panels having different sizes, support conditions, and types of construction. Author

N65-12288# Aerospace Corp., El Segundo, Calif. Systems Research and Planning Div.
THERMOELASTIC DIFFERENTIAL EQUATIONS FOR SHELLS OF ARBITRARY SHAPE
John C. Yao 14 Jan. 1963 13 p refs
(Contract AF 04(695)-169)
(TDR-169(3560-30)TN-4; SSD-TDR-63-20; AD-299558)

Thermoelastic differential equations for shells of arbitrary shape are formulated in the form of Vlasov-type equations, which contain the radial displacement and the Airy-type stress function as the dependent variables and are expressed in terms of the general curvilinear coordinate system. Author

N65-12293# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
CRACK PROPAGATION AND RESIDUAL STRENGTH OF FULL SCALE WING CENTER SECTIONS
D. Broek 8 Apr. 1964 61 p refs
(Contract AF 61(052)-439)
(NLR-TM-S-612; ICAF-291)

Fatigue tests were conducted on eight full-scale wing center sections of the Fokker F.27 aircraft. The specimen consisted of the tension skin, including all stiffening elements. The remainder of the wing was replaced by a dummy structure. Two tests were carried out for each of the following load sequences: (1) random load, (2) programed load, (3) random load with ground-to-air cycles, (4) programed load including ground-to-air cycles. The random loading was based on a simulation of strain-gauge records obtained by flying in turbulent air. The primary aim of the investigation was to study the equivalence of random and programed loadings. A comparison of the crack propagation data indicated the following trends. Crack propagation was slightly higher under a randomly varying load than under a programed load sequence. Addition of the ground-to-air cycles increased crack propagation rates by an amount of about 50%. As for the residual static strength of the structure in the presence of cracks the following can be concluded. If cracks are short the structure behaves like an unstiffened panel. For long cracks the stringers become effective in raising the residual strength. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-10962# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
AN INVESTIGATION OF THE ACCURACY OF NUMERICAL SOLUTIONS OF THE DIFFUSION EQUATION FOR TRANSIENT HEAT TRANSFER
Bart C. Campbell (M.S. Thesis) Aug. 1964 112 p refs
(GSF/Phys/64-1; AD-605489)

This investigation compares the accuracy obtained using two implicit, finite-difference representations of the partial differential equation for transient heat conduction to obtain solutions to two basic conduction problems. The two representations considered are the Crank–Nicolson form and a theoretically optimum form designated as the optimum implicit form. The major source of error occurs at the initial time–space node of the difference mesh. By decreasing this error, the optimum implicit form is shown to be as accurate as the Crank–Nicolson form in one problem, and considerably more accurate in the second. Author

N65-11081# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
PRESSURE AND HEAT TRANSFER MEASUREMENTS AT MACH 13 AND 19 FOR FLOWS AHEAD OF RAMPS, OVER EXPANSION CORNERS, AND PAST FIN-PLATE COMBINATIONS. PART OF AN INVESTIGATION OF HYPERSONIC FLOW SEPARATION AND CONTROL CHARACTERISTICS

Stavros A. Hartofilis Wright-Patterson AFB, Ohio. AF Flight Dyn. Lab., Sep. 1964 56 p refs
(Contract AF 33(616)-8130)
(FDL-TDR-64-144; AD-608040)

This report presents heat transfer and pressure distributions for hypersonic flows ahead of ramps, over expansion corners, and past fin-plate combinations. Two basic models were used for these experiments: (1) a flat plate with a full span ramp (trailing-edge flap) on one surface and an expansion corner on the other; and (2) a flat plate with wedge-shaped fins mounted on the upper surface and an expansion corner on the lower surface. Both sharp leading-edge models were tested in a hypersonic shock tunnel at Mach 13 and 19. The plate-flap model was tested at $\alpha = -15°$ to $+ 30°$, with flap deflections from 0° to 45°, at Reynolds numbers per foot of 0.8×10^5 to 1.4×10^5 at Mach 19 and of 1.2×10^5 at Mach 13. The fin-plate model was tested at $\alpha = 0$ only, with 15° wedge-shaped fins having two different heights at Reynolds number per foot of 2.4×10^5 at Mach 13 and of 0.8×10^5 at Mach 19. Author

N65-11120# Oklahoma U. Research Inst., Norman
DIFFUSION ANALOG OF TWO-DIMENSIONAL HEAT CONDUCTION
H. Hashemi and N. Hardwicke 15 Sep. 1964 15 p ref
(Contract DA-18-035-AMC-116(A))
(TM-1454-5-2; AD-606043)

This paper presents analytical and mechanical methods for determining the dependence of diffusivity on the concentration, and the effect of the phenol concentration in the boundary solvent on the diffusivity of the water-rich phase of the system phenol-water. A one-dimensional cell charged with phenol-saturated water was used to determine the concentration effect. The phenol-saturated water phase forms at the interface after a short time, and diffusion takes place. It was found that the rate of interface movement decreases with an increased phenol concentration in the water. G.G.

N65-11149# Little (Arthur D.) Inc., Cambridge, Mass.
RESEARCH ON THERMODYNAMICS OF THE Al-B-O AND Be-B-O SYSTEMS Quarterly Report, 1 Jun.–31 Aug. 1964
Paul E. Blackburn [1964] 9 p refs
(ARPA Order 315-62)
(QR-9; AD-447633)

The melting point of the mixed $3BeO \cdot B_2O_3$ compound was determined by the temperature difference between a sealed platinum capsule containing Al oxide and that of a second closed capsule with a mixture of BeO and B_2O_2 of the composition $(BeO)_3 \cdot (B_2O_3)_{1.15}$ during cooling. Measurements over the Al-B-O system showed a continuing decrease in B_2O_3 pressure once the phase boundaries were crossed. To suppress possible diffusion effects, measurements were carried out at 1105° C with a cell- orifice area of 5.6×10^{-4} cm^2. The difficulty in obtaining an equilibrium was ascribed to slow nucleation. G.G.

N65-11169# Oklahoma U. Research Inst., Norman
DEVELOPMENT OF DIFFUSION CELL ANALOG FOR SOLVING TRANSIENT HEAT TRANSFER PROBLEMS IN WHICH A PHASE TRANSITION OCCURS
H. Hashemi and C. M. Sliepcevich 15 Sep. 1964 16 p refs
(Contract DA-18-035-AMC-116(A))
(TM-1454-5-1; AD-606042)

The diffusion-cell analog is used for solving the two-dimensional heat-transfer problem with phase transitions. A brief description of the diffusion cell is given, and the concentration profile in the cell and in the liquid passing the boundary is measured from the infringe pattern obtained when the cell is mounted in an interferometer. To simulate various boundary conditions, the distribution flow, as well as the concentration of the incoming liquid, can be adjusted. A theoretical analysis of the analogy between the heat conduction and the molecular diffusion was performed. G.G.

N65-11178# Utah U., Salt Lake City.
IGNITION AND COMBUSTION OF SOLID PROPELLANTS Technical Report, 1 Oct. 1962–30 Sep. 1963
Rex C. Mitchell, John A. Keller, Alva D. Baer, and Norman W. Ryan [1963] 70 p refs
(Grant AF-AFOSR 40-63)
(AD-605729) OTS: $3.00

The spreading rate of the flame zone on the surface of a solid propellant was studied by use of a rarefaction tube. Cold gas flow past the burning zone and across the unburned surface produced high flame spread velocities. The experimental data were interpreted and correlated in terms of two theoretically predicted but experimentally determined parameters. One parameter, which is related to the maximum heat flux produced near the flame front, was found to be independent of gas velocity. The second parameter, which determines the rate of decay of heat flux ahead of the flame front, was found to be independent of pressure. Author

N65-11180# Stanford Research Inst., Menlo Park, Calif.
PRESSURE TRANSDUCER FOR MEASURING SHOCK WAVE PROFILES ADDITIONAL GAGE DEVELOPMENT Progress Report, 1–31 Aug. 1964
D. D. Keough, P. H. Moravek, and R. F. Williams 2 Sep. 1964 22 p refs
(Contract DA-49-146-XZ-096; DA-49-146-XZ-280)
(PR-36; AD-605229)

Temperature effects on pressure transducers for measuring shock-wave profiles are investigated to determine a temperature vs time relation for the Manganin gage wire. Calculated Hugoniot temperatures for the C-7 epoxy insulator for pressures exceeding 500 kilobars for four slightly different Grüneisen's ratios are presented. The method used in these computations is described and comparisons of these data with the results obtained by different methods are planned. The feasibility of constructing field-test gages that are principally of the native medium of a given field test has been demonstrated with a Manganin wire assembly in limestone. Materials are being investigated for a low-pressure transducer, using high-density insulators and metallic elements as piezoresistive materials. M.P.G.

N65-11212# Atomics International, Canoga Park, Calif.
RADIOLYSIS PRODUCTS OF POLYPHENYL COOLANTS. PART II: LOW AND INTERMEDIATE BOILERS
R. A. Baxter, R. C Shepard, W. L. Orr, L. J. Miller, R. T. Keen et al Oct. 1964 36 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9733) OTS: $0.75

Low boilers are defined for OMRE coolant as those compounds in the boiling range, 80° to 254° C, and intermediate boilers are defined as those in the range, 254° to 383° C. Nine of the 21 detectable low boilers were identified. These are benzene, toluene, ethylbenzene, m- and/or p-xylene, ethyltoluene, trimethylbenzene, n-propylbenzene, n-butylbenzene, and indane. Four of the 13 detectable intermediate boilers were identified as 3-methylbiphenyl, fluorene, phenanthrene, and fluorenone. Author

N65-11286# Stanford U., Calif.
HEAT TRANSFER FROM A NONSPHERICAL BUBBLE RISING IN AN ISOTHERMAL LIQUID
L. S. Langston and R. H. Eustis 20 Apr. 1964 213 p refs
(NSF G-13399)

The transient heat-transfer characteristics of single, heated, nonspherical bubbles rising in an isothermal liquid were studied. While in free ascension in a glycerine medium, each bubble was heated by rapid compression. As the bubble cooled at constant pressure, its heat transfer characteristics were recorded through photographic measurement. Mass transfer effects were excluded by using the relatively insoluble gas xenon. All bubbles studied fell into a stable ellipsoidal regime, with Reynolds numbers ranging from 1 to 31. Coupled with earlier data on spherical bubbles, it was found that a lower limit to the rate of heat transfer could be accurately predicted and that an upper limit to the rate of heat transfer from spherical bubbles existed. As bubble distortion occurred, the rate of heat transfer was found to increase beyond this upper limit. Author

N65-11405*# Michigan U., Ann Arbor Coll. of Engineering
TRANSIENT, LAMINAR, FREE-CONVECTION HEAT AND MASS TRANSFER IN CLOSED, PARTIALLY FILLED, LIQUID CONTAINERS Technical Report No. 1
John A. Clark and Hussein Z. Barakat Jan. 1964 69 p refs
Its Rept.-04268-6-T
(Contract NAS8-825)
(NASA-CR-59568) OTS Prices: HC $3.00/MF $0.75

The two-dimensional, laminar, transient, natural convection heat and mass transfer in a closed rectangular container with a free surface is studied. The x-momentum, the y-momentum, and the continuity equations are coupled to obtain the vorticity transport equation, which is integrated numerically using the finite-difference approximation. The problem of stability, which is associated with difference equations is studied. The convergence of the solution of the difference equations to that of the differential equation is examined. Results of the calculations for different boundary conditions are given. Comparison of the theoretical results with two experimental measurements from the literature indicates qualitative agreement. Author

N65-11413# Edgerton, Germeshausen and Grier, Inc., Boston, Mass.
RADIANT PROPERTIES OF HIGH TEMPERATURE EQUILIBRIUM AIR (3800 Å TO 6500 Å)
Ernest N. Ashley, Jr. 22 May 1964 186 p refs
(Contract DA-49-146-XZ-188)
(B-2782; DASA-1506; AD-607069)

The linear spectral absorption coefficient and related radiative quantities have been computed for high-temperature equilibrium air for optical wavelengths within the range of 3800 to 6500 Å. The computations were performed over temperatures from 1000° to 24 000° K, and for density ratios (ρ/ρ_0) from 1 to 10^{-6}. Quantities computed include the linear absorption coefficients for the radiating constituents of high-temperature air, the total absorption coefficient, the spectral emissivity and radiance of a 1-cm layer of air, and mean emissivities, radiances and absorption coefficients for the optical band. A description of the theoretical considerations that served as the basis of calculations is given. The results of the computations are presented in the form of graphs and tables covering the specified wavelength, temperature, and density regions. Author

N65-11429# Aerochem Research Labs., Inc., Princeton, N.J.
IONIZATION IN ROCKET EXHAUST PLUMES
Daniel E. Rosner Apr. 1964 80 p refs
(Contract AF 30(602)-3142)
(AEROCHEM-TP-85; AD-447304)

Aerodynamic, thermodynamic, and chemical kinetic factors governing electron concentrations in the exhaust plumes of rocket motors are discussed, with emphasis on the quantitative prediction of radar attenuation trends with changes in trajectory and/or propulsion system characteristics. Author

N65-11475# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE QUESTION ABOUT MECHANISM OF INFLUENCE OF LIQUID LAYER DURING BURNING OF MIXED SYSTEMS
A. P. Glazkova 28 May 1964 12 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 37, no. 5, 1963 p 1119-1123
(FTD-MT-64-25; AD-605889)

Burning phenomena of mixtures that use perchlorates of ammonium and potassium as oxidizers with both fusible and infusible fuels were investigated in the pressure range of from 1 to 350 atm. Results reported indicate that if, while burning, one of the components of the mixture changes to the liquid state, the mixture burns according to a mechanism that is similar to the mechanism of burning of individual explosive substances. M.P.G.

N65-11578# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TURBULENT HEAT AND MASS TRANSFER IN JET MOTION OF A GAS
L. A. Vulis 17 Mar. 1964 26 p refs Transl. into ENGLISH from Vopr. Aerodinamiki (USSR), 1958 p 81-99
(FTD-MT-63-208; AD-605863)

This is a short survey of certain thermal conditions, both for an incompressible liquid and also for a variable gas in a field of flow, with emphasis on the relationship between the turbulent transfer coefficients of momentum and heat (or mass). Presented are "half-free" thermal-diffusion streams propagating in a hard wall, the heat exchange in complex jets and in the tracking of a body, and studies of twisted flows under conditions of strong twisting. An explanation is given of the possibility of a generalization in the case of compressible twisted streams. G.G.

N65-11583# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATIONS ON THE TRANSITION OF BURNING OF EXPLOSIVES INTO EXPLOSION
K. K. Andreyev and S. V. Chuyko 25 Feb. 1964 19 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 37 no. 6, 1963 p 1304-1310
(FTD-MT-63-243; AD-602570)

The burning transitions of three powdery explosives—PETN, hexogen, and tetryl—were investigated by photographic techniques at constant increased pressures of inert nitrogen gas up to 1000 atm. In the low-pressure region, the burning of powdery explosives of low density does not differ in speed and character from the burning of solid explosives. Above a certain pressure, which varies with relative density and particle size, the burning changes into an accelerated regime whose average speed exceeds by 10 to 100 times the rate of normal burning. This accelerated burning rate is approximately constant and grows differentially with pressure, depending on the density and dimensions of the explosive particles. Burning at constant pressure did not change into explosion in the studied range of pressures and particle sizes. The relative stability of burning was found to be significantly determined by the relationship between dilution of the explosive by nitrogen and the particle dispersion. M.P.G.

N65-11595# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ABOUT TAE MECHANISM OF COMBUSTION OF POWDERS

P. F. Pokhil and V. M. Mal'tsev 30 Mar. 1964 12 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 6, no. 6 1963 p 94–99
(FTD-MT-63-242; AD-606751)

Experimental data are listed for the study of the main physical properties of a flame of solid fuel—nitroglycerine powder and explosive hexogene—during combustion in a bomb of constant pressure. Author

N65-11692# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
SENSITIVITY CHARACTERISTICS OF LIQUID EXPLOSIVE SYSTEMS Progress Report, 1 Jul.–30 Sep. 1964
Frank C. Gibson, John Ribovich, and J. Edmund Hay Nov. 1964 21 p refs
(BUWEPS Order IPR-19-64-8026-WEPS)
(PR-11)

Shock sensitivity scales were established for the nitroglycerin-ethyleneglycol dinitrate–triacetin system in aluminum, plexiglas, and polyethylene containers. Threshold gap thicknesses of various solvents were determined in an aluminum pipe using a tetryl donor, and a relationship of the shock sensitivity to the oxygen balance in the casting of solvent samples was established. The sensitivity values dropped off with the decrease in the oxygen balance. Despite the low pressures and rates observed for polyethylene containers, there was little difference in the shock sensitivities found for polyethylene and plexiglas containers. G.G.

N65-11696# Lockheed Nuclear Products, Marietta, Ga.
FREE CONVECTION IN ROCKET PROPELLANT TANKS
J.W. Tatom, L. H. Knight, W. B. Brown, and T. A. O'Grady May 1963 74 p refs
(ER-6216)

Results of research on free-convection heat transfer are discussed in the following areas: (1) turbulent free convection with a constant wall-heat flux and a uniform body force; (2) laminar and turbulent free convection with a constant wall-heat flux and a linearly varying body force; (3) thermal stratification of liquid hydrogen in a missile propellant tank; (4) effects of intense noise on free-convection heat transfer and boundary-layer characteristics; and (5) use of photographic techniques for measuring free-convection velocities. M.P.G.

N65-11698# Naval Ordnance Lab., White Oak, Md. Physical Chemistry Div.
THE CRITICAL CONDITIONS IN THERMAL EXPLOSION THEORY FOR nth ORDER REACTIONS
J. Adler (Imperial Coll. of Sci. and Technol., London) and Julius W. Enig Nov. 1964 10 p ref
(NOLTR-64-180; AD-450970)

The energy and chemical kinetic equations describing the behavior of a symmetrically heated reactive material with finite heat of reaction are considered. A previous investigation of the relationship between the parameters at criticality had shown that the condition arises from a mathematical analysis of the problem. In the present paper, the previous results are extended to cases where the material decomposes exothermically according to an nth-order single-step reaction. P.V.E.

N65-11700# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.
THE SHOCK TO DETONATION TRANSITION IN COMPOSITE AND DOUBLE BASE PROPELLANTS
N. L. Coleburn Dec. 1964 23 p refs
(NOLTR-64-75; AD-451263)

Plane shock wave compressions were used to obtain the unreacted shock Hugoniots of a composite and a double base propellant. One propellant contained a hybrid explosive mixture. For this propellant smear camera measurements were made of the shock velocity buildup to steady detonation velocity as a function of travel distance in wedge-shaped specimens, for entering pressures of 62.4, 72.3, and 78.9 kilobars. These measurements showed the propellant to be as sensitive to rapidly applied shocks as cast Composition B. Under similar shock pressures (>80 kilobars) the second (NOL developed) propellant, which contained no explosive, burned uneventfully without detonating. Author

N65-11894# Michigan U., Ann Arbor Liquid Metals Lab.
INVESTIGATION OF LIQUID METAL BOILING HEAT TRANSFER Fifth Quarterly Progress Report, May 15–Sep. 15, 1964
Richard E. Balzhiser, Robert E. Barry, Bruce F. Caswell, Herman Merte, Jr., and Andrew Padilla, Jr. Sep. 1964 46 p refs
(Contract AF 33(657)-11548)
(Rept.-05750-16-P; AD-606826)

A numerical analysis of the edge effects in the 1-inch-diameter film boiling apparatus has been completed. The uncertainty in condensing coefficients for sodium beneath the plate makes it difficult to correct for the large amount of heat that flows up the wall when the system operates in the film regime. A design for a modified boiler is presented. The forced-convection apparatus was reassembled after the zirconium chips in the hot trap were replaced. Filters were added at several points in the system to collect suspended solids or oxide if either existed in the system. Despite all efforts plugs still developed and flow was obtained for only brief periods during this time. The agravic apparatus was operated with mercury at a/g of one. Data were obtained in the nucleate, transition, and film regimes. Author

N65-11910# MSA Research Corp., Callery, Pa.
EXTINGUISHMENT OF ALKALI METAL FIRES Technical Documentary Report, Feb. 1962–Jul. 1964
S. J. Rodgers and W. A. Everson Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Oct. 1964 96 p refs
(Contract AF 33(657)-8310)
(APL-TDR-64-114; AD-607978)

The effects of inert gas blanketing and oxygen partial pressure were evaluated. It was found that reduction of oxygen partial pressure was effective in inhibiting ignition and degree of combustion of lithium, sodium, NaK, and potassium. Rubidium and cesium did not ignite, i.e., there was no emission of smoke or flame, but they completely oxidized even at lower oxygen partial pressures. Reduced-oxygen partial pressure was also effective in inhibiting ignition of alkali-metal jet streams. A number of different salts, organic liquids and polyurethane foam were evaluated with respect to alkali metal fire extinguishment. A typical alkali-metal system that might be used to generate electrical power in space is discussed. The major fire hazards during the various phases of charging, injection into orbit and in-flight operations are outlined. Fire control procedures for each of the phases are outlined. Author

N65-11924# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
THERMAL DIFFUSION OF ANTIMONY AND RUTHENIUM IN SILVER
W. Biermann, D. Heitkamp, and T. S. Lundy Nov. 1964 64 p refs
(Contract W-7405-ENG-26)
(ORNL-3710)

The redistribution of antimony and ruthenium in very dilute solid solutions in silver under a temperature gradient was investigated by using radioactive tracer techniques. The experiments showed that the concentration of antimony increased at the hot side of the specimens and decreased at the cold side. The steady-state concentration was given by a straight line in a plot of the logarithm of the antimony concentration versus the reciprocal absolute temperature. The redistribution could be described by an unusually large negative heat of transport, $Q^* = (-29 \pm 3)$ kcal/mole. The concentration profile for ruthenium in silver annealed under a temperature gradient was quite different from any redistribution that could be explained by thermal diffusion alone. No heat of transport could be calculated from the determined ruthenium concentration; the profile suggests only a negative value for the heat of transport for pure silver. Author

N65-11935# Oak Ridge National Lab., Tenn.
PROCEEDINGS OF 1963 HIGH-TEMPERATURE LIQUID-METAL HEAT TRANSFER TECHNOLOGY MEETING, VOLUME I
Nov. 1964 386 p refs Meeting held at Oak Ridge Natl. Lab., 4–6 Sep. 1963; sponsored by AEC
(Contract W-7405-ENG-26)
(ORNL-3605, Vol. I) OTS: $7.00

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N65-11937# Aerojet-General Nucleonics, San Ramon, Calif.
THE DETERMINATION OF THE LATENT HEAT OF VAPORIZATION, VAPOR PRESSURE, ENTHALPY AND DENSITY OF LIQUID RUBIDIUM AND CESIUM UP TO 1800° F
P. Y. Achener *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 3–25 refs (See N65-11935 02-33) OTS: $7.00
(AGN-TP-71)

The thermodynamic properties of rubidium and cesium and the equipment used to measure them are described. To date, the latent heat of vaporization from 1000° to 1800° F for Rb, from 1000° to 1600° F for Cs, the enthalpy and specific heat from 160° to 1650° F for both Rb and Cs, and the density of the saturated liquid have been determined experimentally. Discussions of the results obtained in each case are included. M.P.G.

N65-11938# MSA Research Corp., Callery, Pa.
THERMOPHYSICAL PROPERTIES OF RUBIDIUM AND CESIUM
F. Tepper, A. Murchison, J. Zelenak, and F. Roehlich *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 26–65 refs (See N65-11935 02-33) OTS: $7.00

Determinations of thermophysical properties of rubidium metal and cesium at temperatures to 2000° F are reported. A large part of the program has been devoted to establishing techniques for analyzing trace impurities in these alkali metals; the methods selected for the various impurity contents are described. Thermophysical measurements reported include vapor pressure of both Rb and Cs, density and electrical resistivity of liquid Rb, and the specific heat of liquid Rb and liquid Cs, as well as the density of liquid Cs to 708° F. The obtained data are tabulated and discussed. M.P.G.

N65-11939# Oak Ridge National Lab., Tenn.
THERMOPHYSICAL PROPERTY MEASUREMENTS OF ALKALI LIQUID METALS
J. W. Cooke *In Its* Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 66–87 refs (See N65-11935 02–33) OTS: $7.00

The final results of the experimental determination of the thermal conductivity of 99.8+ wt % molten from lithium 320° to 830° C are reported. The preliminary results just obtained for the surface tension of 99.97 wt % molten potassium from 70° to 713° C using a maximum bubble-pressure apparatus are also given. Author

N65-11940# Battelle Memorial Inst., Columbus, Ohio
THE THERMODYNAMIC AND TRANSPORT PROPERTIES OF POTASSIUM
A. W. Lemmon, Jr., H. W. Deem, E. H. Hall, and J. F. Walling *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 88–115 refs (See N65-11935 02-33) OTS: $7.00
(Contract NAS5-584)

Experimental thermodynamic measurements of liquid enthalpy, vapor pressure, and gas compressibility of potassium at temperatures up to 2100° F are described, and the results

are reported. These data were used to derive values for solid, liquid, and vapor specific heat, heat of fusion, and heat of vaporization, and to construct an enthalpy–entropy diagram. Transport property measurements were made of the liquid viscosity, the liquid thermal conductivity, and the liquid electrical conductivity. These results are also reported to 2100° F. For all results, comparisons were made with previous information when such was available. Author

N65-11941# Columbia U., New York, N.Y. Liquid Metal Research Lab.
THERMOELECTRIC POTENTIALS OF MOLTEN AND REFRACTORY METALS. I. SEEBECK POTENTIALS OF SODIUM, POTASSIUM, RUBIDIUM, CESIUM, AND MERCURY VS. PLATINUM AND OTHER METALS
Charles F. Bonilla, Roland R. Kyi, Howard T. Drue, and Do-ik Lee *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 116–138 refs (See N65-11935 02-33)
(Contracts AT(30-1)-1042; AT(30-1)-2660; AF 33(616)-7368) OTS: $7.00

After reviewing principles of liquid-metal thermoelectricity and some proposed applications of the thermoelectric potential, methods used to determine the thermal emf of liquid and solid metals are described. Results are tabulated and discussed for the thermal emf's of the following: (1) nickel, 304 and 316 stainless steels, L-605, iron, and molybdenum solid metals vs platinum from 25° to 900° C; (2) mercury vs iron with cold junction at 0° C; and (3) mercury, sodium, potassium, cesium, and rubidium liquid-metals vs. platinum from 25° to 900° C. The obtained data are compared with data reported by others, when available, and the metallic impurities in the alkali metals used in these studies are included for reference. M.P.G.

N65-11942# Geoscience Ltd., La Jolla, Calif.
REPORT ON HIGH TEMPERATURE LIQUID METAL HEAT TRANSFER RESEARCH AT GEOSCIENCE LTD.
H. F. Poppendiek and N. D. Greene *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 139–170 refs (See N65-11935 02-33) OTS: $7.00

Analytical and experimental studies of liquid-metal boiling and condensing, with emphasis on high gravity and rotational flow, are reported. Results are being used to develop design correlations and criteria for predicting nuclear-reactor and heat-exchanger performance. Associated problems of the influence of coolant void perturbations on neutron and heat flux, as well as the effect of boiler tube wall-temperature fluctuations on metal fatigue are considered. Among the analytical heat-transfer models being considered are fluid drop and fog flows; experiments conducted using liquid-metal heat-transfer systems have given boiling-mercury and boiling-water data that permit comparisons to be drawn between linear and rotational flow boiling in both the high and low vapor-quality regions. M.P.G.

N65-11944# Argonne National Lab., Ill.
HEAT TRANSFER COEFFICIENT IN LIQUID METAL CO-CURRENT FLOW DOUBLE PIPE HEAT EXCHANGERS
Ralph P. Stein *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 194–239 refs (See N65-11935 02–33) OTS: $7.00

An analytical study of heat transfer in co-current flow double-pipe heat exchangers is described. Although the analysis is based on plug flow models of the heat exchanging fluids, an approximation method is developed which allows application to the turbulent flow of liquid metals with good accuracy indicated up to Peclet numbers of 1000. The analysis is applied to the prediction of fully developed individual-channel (film) heat-transfer coefficients. Author

N65-11945# Hercules Power Co., Cumberland, Md. Allegany Ballistics Lab.
NATURAL CONVECTION HEAT TRANSFER COEFFICIENTS FOR LIQUID TIN AT HIGH HEAT FLUXES
Akbar F. Brinsmade and Leland G. Desmon *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 240–262 refs (See N65-11935 02-33) OTS: $7.00

Natural-convection liquid-metal heat-transfer measurements were made in a rocket nozzle containing refractory-metal calorimetric devices utilizing tin as a heat-transfer agent. Test variables included propellant-gas throat-stagnation temperatures in excess of 5000° F, acceleration to 1.18 g and heat fluxes to 1.72×10^5 Btu/hr $\times$ ft^2. Test data, a natural convection correlation for tin, and a comparison with sodium and lithium are presented. Author

N65-11946# Massachusetts Inst. of Tech., Cambridge
THE EFFECT OF SURFACE CONDITIONS ON POOL BOILING HEAT TRANSFER OF SODIUM
P. J. Marto and W. M. Rohsenow *In* Oak Ridge Nat. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 263–285 refs (See N65-11935 02-33) OTS: $7.00
(NSF GP-14421)

An apparatus is described that has been designed to obtain reproducible pool-boiling sodium data for a given set of boiling surface conditions, and to investigate the effect of various surface finishes and additives on the nucleate pool-boiling sodium curve. In this system, sodium boils off a flat plate, rises up a vertical pipe, and condenses due to forced convection of air. The major components of the apparatus are described in detail, and it is reported that construction is about 80% completed. M.P.G.

N65-11947# Columbia U., New York, N.Y. Liquid Metals Research Lab.
POOL BOILING OF POTASSIUM
Charles F. Bonilla, Mark M. Wiener, and Hans Bilfinger *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 286–309 refs (See N65-11935 02-33) OTS: $7.00
(Contracts NAS5-681; NAS3-2528)

A review of previous liquid-metal pool-boiling experimental work is presented to show that no data were available on the boiling of potassium at high heat fluxes prior to the studies reported. Data obtained using existing equipment are tabulated and plotted for pressures from 2.25 to 1500 mm Hg; a clear-cut separation of the data into low-pressure and high-pressure values is evident with the latter having approximately 5 times as high a heat-transfer coefficient at the same heat flux. Only moderate agreement with correlations that have been proposed for liquid metals was obtained, indicating that further improvement in correlations, including the effect of roughness and metal, is needed before pool-boiling predictions for liquid metals can be made with confidence. An advanced type of potassium pool boiler that has been designed for work at higher pressures, heat fluxes, and roughnesses is described and illustrated. M.P.G.

N65-11948# Oak Ridge National Lab., Tenn.
SUPERHEAT REQUIREMENTS WITH BOILING LIQUID METALS
A. I. Krakoviak *In its* Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 310–333 refs (See N65-11935 02-33) OTS: $7.00

A brief review is presented of boiling for ordinary fluids, with emphasis on the wall superheat required for bubble initiation from a heated surface. Calculations based on an equation valid for normal fluids indicate that superheats from two to eight times that for water are required to initiate a vapor bubble in some of the alkali metals. This high superheat and the high

thermal conductivity peculiar to liquid metals are combined to explain the unstable liquid-metal boiling phenomenon in natural- and forced-circulation loops. Author

N65-11949# Oak Ridge National Lab., Tenn.
RECENT EXPERIMENTAL RESULTS IN ORNL STUDIES WITH BOILING POTASSIUM
H. W. Hoffman *In its* Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 334–350 refs (See N65-11935 02–33) OTS: $7.00

Recent results of continued studies into the forced-convection saturation boiling of potassium in a vertical, circular tube are reported. Heat-transfer data, for conditions below the critical heat flux, were explained in terms of an annular flow with surface evaporation. Critical heat-flux values continued to agree with a correlation developed for water by Lowdermilk, Lanzo, and Siegel. A consistent pattern was observed for the pressure drop across the boiler; the data, however, include indeterminate losses at the boiler entrance and exit. New boiler sections, designed to provide data on the fluid-temperature distribution, are described. A program to obtain data on the critical heat flux in a multirod geometry as a function of rod spacing is discussed. Author

N65-11950# Michigan U., Ann Arbor
BOILING STUDIES WITH POTASSIUM
Richard E. Balzhiser *In* Oak Ridge Natl. Lab. Proc. of 1963 High-Temp. Liquid-Metal Heat Transfer Technol. Meeting Nov. 1964 p 351–371 refs (See N65-11935 02-33) OTS: $7.00

Four liquid-metal boiling studies are reported: (1) pool boiling in the high-flux nucleate regime; (2) pool boiling encompassing the entire boiling range with special emphasis on transitional and film boiling; (3) a forced-circulation study to obtain local heat-transfer coefficients and two-phase pressure drop and void-fraction data; and (4) effects of acceleration on the boiling process. Mercury is being used as the test fluid in (4); all other phases are employing potassium initially. The equipment being used for each of these studies is described, and results obtained in (1) are discussed, including burnout data for saturated potassium boiling from the surface of a 3/8-in. bayonet tube, at pressures in excess of 1 atm. M.P.G.

N65-11981# Syracuse U., N.Y.
THE EFFECTS OF DISSIPATION, COMPRESSION WORK, UNSYMMETRICAL BOUNDARY CONDITIONS AND VARIABLE WALL TEMPERATURES ON TURBULENT HEAT TRANSFER
Jose A. Blanco, Shaw Mei Lee, and William N. Gill [1964] 39 p refs
(Contract ONR-669(17); NSF-GP-1137)

The effect of different wall temperatures, dissipation, and compression work on laminar and turbulent entrance region forced convection heat transfer is analyzed for arbitrary wall temperature systems, and numerical results are given for the cases of constant and linear wall temperature. It is shown that heat transfer characteristics can be altered significantly, and in some cases these effects are sufficiently important to change the direction of heat flux at the walls. The first ten eigenvalues and eigenfunctions, five even and five odd, were calculated for the basic Sturm–Liouville problem for sixteen combinations of N_{Re} and N_{Pr}. These basic functions were then used to investigate the effect of the various parameters on the heat transfer in the thermal entrance region of turbulent flows between parallel plates. For the asymptotic region at large distances from the thermal entrance, results are reported for a very wide range of parameters. Author

N65-11997# Union Carbide Research Inst., Tarrytown, N.Y.
HEAT OF SUBLIMATION OF PALLADIUM
O. C. Trulson and P. O. Schissel Aug. 1964 8 p refs
(Contract DA-30-069-ORD-2787)
(C-23; AD-449865)

The heat of sublimation of palladium metal has been determined from relative vapor pressure measurements made with a Knudsen-cell effusion source and a mass spectrometer detector. The average heat of sublimation obtained from eleven runs is $\Delta H_{298} = 91.2 \pm 0.9$ kcal/mole. Molecular species other than the Pd monomer were not observed at 1748° K, with an instrument sensitivity of better than 0.1% of the Pd signal. Author

N65-12042# ARO, Inc., Arnold Air Force Station, Tenn.
EFFECT OF SHOCK IMPINGEMENT ON THE HEAT-TRANSFER AND PRESSURE DISTRIBUTIONS ON A CYLINDRICAL-LEADING-EDGE MODEL AT MACH NUMBER 19
L. G. Siler and H. E. Deskins Arnold Eng. Develop. Center, Nov. 1964 32 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-228; AD-451128)

Pressure and heat-transfer measurements on a cylindrical-leading-edge model with and without the influence of an impinging shock wave were made in a wind tunnel at about Mach number 19 and Reynolds number of approximately 24 000 per inch. The configuration was evaluated through a sweep range from 0° to 75° while varying the shock generator angle from 0° to 40° Author

N65-12079*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
EXPERIMENTAL HEAT-TRANSFER AND BOUNDARY-LAYER BEHAVIOR WITH 100-CPS FLOW OSCILLATIONS
Charles E. Feiler Washington, NASA, Dec. 1964 24 p refs
(NASA-TN-D-2521) OTS Prices: HC $1.00/MF $0.50

The time-averaged heat-transfer rates and the velocity and temperature profiles on a cylinder in parallel subsonic airflow were measured in both steady and oscillating flows. In the steady reference flow, a laminar boundary layer and laminar heat transfer that agree with the Blasius relations were obtained for Reynolds numbers less than about 10^5. By addition of a boundary-layer trip, transition to a turbulent layer was induced, transition having started at a Reynolds number of about 3×10^4. The data for the oscillating flow were compared with these two reference conditions. The results, without the boundary-layer trip, indicated that the effect of the oscillation was induced transition to turbulent flow. The only effect of the boundary-layer trip in oscillating flow was a further reduction in transition Reynolds number. Author

N65-12109# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SHOCK-LAYER RADIATION FOR SPHERE-CONES WITH RADIATIVE DECAY
Jin H. Chin and L. F. Hearne 15 Mar. 1964 13 p refs

This paper presents approximate methods for the determination of the effect of radiative decay on the shock-layer radiation toward sphere–cones. As the gas particles travel downstream from the shock wave, the enthalpy decays as a result of radiation loss. The shock layer is approximated by a semi-infinite plane-parallel slab having the local shock-layer thickness and radiation distribution; the adiabatic shock-layer thickness was obtained from the constant-density solutions. The effect of radiative decay on the ratio of the local radiative flux to stagnation radiative flux was found to be relatively small, and first-order radiation calculations of the shock-layer radiation for sphere–cones could be applied without difficulty. G.G.

N65-12116# Warner and Swasey Co., Flushing, N.Y. Control Instrument Div.
PREDICTING INFRARED ABSORPTANCES OF HOT GASES: METHODS AND APPLICATIONS
G. Jordan Maclay and Harold J. Babrov Jun. 1964 62 p refs (Contract Nonr-3657(00); ARPA Order 237-62; Proj. Defender) (AD-446254)

The spectral radiances of flames can be determined once the temperatures and spectral absorptances are known. Techniques for predicting the infrared spectral absorptances of flames and other hot gas mixtures were developed, using band models, and were applied to CO_2, H_2O, and HCl. In addition, exact theoretical methods of predicting the integrated absorptance were applied to H_2O. The Elsasser, random Elsasser, and statistical band models were used, and methods were developed for fitting a band model to a spectrum with known line frequencies, strengths, and half-widths. Random Elsasser and statistical band model parameters were calculated for the HCl fundamental band. The HCl absorptances predicted using the band models were in close agreement with experiment. The random Elsasser model gave the best agreement with experiment for HCl. The statistical model predicted absorptances slightly lower than experiment. Author

N65-12165# Air Force Systems Command, Wright-Patterson AFB, Ohio AF Flight Dynamics Lab.
AERODYNAMIC HEATING SIMULATION. PART I: THEORY AND PROGRAM DEFINITION
Glendon R. Crump Sep. 1964 42 p refs (FDL-TDR-64-112, Pt. 1; AD-608070)

This study determines how accurately aerodynamic heating is simulated in the laboratory with radiant heat lamps under computer control. A study of aerodynamic heating theory resulted in the preparation of a digital computer program for calculating the parameters required as input data for the heat-rate computer. The heat-rate computer is used to control the heat input to an actual flight test specimen. Laboratory test results are compared with flight-measured data to determine the degree of simulation. Test results indicate that aerodynamic heating may be adequately simulated up to 600° F. Author

N65-12180# Battelle Memorial Inst., Columbus, Ohio
A MODEL STUDY OF THE INTERACTION EFFECTS OF MASS FIRES Summary Report No. 3
I. M. Grinberg and A. A. Putnam 28 Sep. 1964 49 p refs (Contract NBS-CST-1104) (AD-448118)

A technique is presented for evaluating the observations of flames of one fuel with regard to their application to large fire masses in which other fuels are consumed. The independent effects of the adiabatic flame temperature, the stoichiometric air–fuel ratio, and the fuel density of the flame characteristics were observed. A formula was developed to correlate the temperature profile of a turbulent diffusion, buoyancy-controlled flame to the fuel properties and flow conditions. This correlation was supported experimentally by the use of fuels of different diameters. G.G.

N65-12216*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
RADIATION PROCESSES RELATED TO OXYGEN-HYDROGEN COMBUSTION AT HIGH PRESSURES
Marshall C. Burrows Washington, NASA, Dec. 1964 15 p refs Previously announced as NASA-TM-X-52023; See N64-20576 13-26
(NASA-TN-D-2541) OTS Prices: HC $0.50/MF $0.50

Radiation related to the combustion of liquid-oxygen jets in a gaseous hydrogen atmosphere was studied by measuring the intensities of the hydroxyl radical, oxygen, and water radiation in a combustion chamber equipped with windows. Overall oxidant–fuel weight ratio was varied from 1 to 10 at a chamber pressure of 24 atmospheres. Maximum intensities from the radiating species were obtained near stoichiometric mixture ratios. Gas temperatures derived from the measured color temperature of a tungsten plate in the gas stream agreed with theoretical temperatures of the products. Gas radiation appeared to be thermally excited and in local equilibrium at all locations within the combustor. Author

N65-12217*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
RELATION OF EMITTED ULTRAVIOLET RADIATION TO COMBUSTION OF HYDROGEN AND OXYGEN AT 20 ATMOSPHERES
Marshall C. Burrows and Ronald Razner Washington, NASA, Dec. 1964 25 p refs
(NASA-TN-D-2548) OTS Prices: HC $1.00/MF $0.50

Emitted radiation from the combustion of gaseous hydrogen and liquid oxygen was measured in the spectral range from 2500 to 4500 Å. Pressure in the combustion chamber was maintained at approximately 20 atm. The hydroxyl radical emitted strongly in the region between 2500 and 3500 Å. Principal molecular oxygen emission extended from 3000 to 4000 Å. Background or continuum radiation extended throughout the observed spectral range. Analysis of radiation from the OH radical showed that OH was in thermal equilibrium with its surroundings, in both the reaction zone and in the mixed products of reaction. Radiating OH and O_2 lines were severely self-absorbed in all bands because of the cool combustor boundaries and gas mixtures with nonuniform temperature profiles. Author

N65-12262#. Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
PROJECT COLD SHOT: PARTICLE THERMAL RADIATOR
Garrett Wilbur Durling, Jr. (M.S. Thesis) Aug. 1964 53 p refs (GA/Phys/64-1; AD-605485)

The heating of small metallic particles during impact on a charged hot surface is studied experimentally. A proposed radiator design for space application uses particles heated in this manner to produce a lightweight radiator with a large radiating surface. Previous theoretical studies of this design assumed that the particle was heated to almost 100% of the hot surface temperature before being repelled from the surface; the purpose of this study was to investigate that assumption. In a vacuum of three micromillimeters of mercury the particles were bounced off a surface on which a temperature as high as 155° C and a perpendicular electric field as high as 100 000 volts per meter were maintained. The particles were collected in a calorimeter where the amount of heat gained by them was measured. Negligible heat transfer was indicated with typical test results showing a change in particle temperature of 0.45° ±0.89° C, and a heat gain of only 0.37% ±0.72% of the amount required to raise the particle temperature to that of the hot surface. Author

N65-12272*# National Aeronautics and Space Administration, Washington, D.C.
TABLES OF HEAT CAPACITY AND ENTHALPY OF WATER AND STEAM [TABLITSY OPORNYKH TOCHEK TEPLOYEMKOSTI I ENTAL'PII VODY I VODYANOGO PARA]
A. M. Sirota, B. K. Mal'tsev, and P. Ye. Balyakova Dec. 1964 19 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 10, no. 5, 1963 p 64–69
(NASA-TT-F-9208) OTS Prices: HC $1.00/MF $0.50

Experiments on the heat capacity of water and steam at various pressures are presented. Comparison is made between results obtained previously under less adequate conditions and those made more recently with improved methods and equipment. Resistance thermometers and thermostat resistance coils were used in the tests. A discussion is given concerning the

accuracy of measuring c_p in the critical zone. Various disparities between authors regarding the values in the critical zone are discussed. Tables and equations are provided that illustrate the methods used. Author

N65-12305*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ANALYTIC SOLUTIONS TO THE IGNITION KINETICS OF THE HYDROGEN-OXYGEN REACTION
Richard S. Brokaw Washington, NASA, Dec. 1964 17 p refs Presented at the 10th Intern. Symp. on Combust., Cambridge, London, 17–21 Aug. 1964
(NASA-TN-D-2542) OTS Prices: HC $1.00/MF $0.50

Solutions have been obtained by assuming isothermal conditions and negligible depletion of reactants during the induction period for the following scheme of reactions:

$$OH + H_2 \xrightarrow{k_1} H_2O + H,$$
$$H + O_2 \xrightarrow{k_2} OH + O,$$
$$O + H_2 \xrightarrow{k_3} OH + H,$$
$$H + O_2 + M \xrightarrow{k_6} HO_2 + M, \text{ and}$$
$$HO_2 + H_2 \xrightarrow{k_{11}} H_2O_2 + H.$$

Three types of solutions have been deduced corresponding to $K_6c_M > 2k_2$ (a low temperature–high pressure region of long ignition delays), $2k_2 > k_6c_M$ (a high temperature–low pressure region of short delays), and $2k_2 = k_6c_M$ (the boundary between the two regions). Experimental ignition delays in both long- and short-delay regions are explained, and ignition delays computed by numerical integration of the rate equations are reproduced to within a few percent. Ignition delays for the Von Neumann spike condition in Chapman–Jouguet detonations in the neighborhood of the lean limit of detonability in air have been calculated. Author

N65-12307*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
GRADUAL TRANSITION OF NUCLEATE BOILING FROM DISCRETE-BUBBLE REGIME TO MULTIBUBBLE REGIME
Yih-Yun Hsu Washington, NASA, Dec. 1964 70 p refs
(NASA-TN-D-2564) OTS Prices: HC $3.00/MF $0.75

A photographic study was made of over 5000 bubbles in the nucleate boiling of methanol and water on a narrow heating strip at various heat fluxes and degrees of subcooling. The results showed that transition from the discrete-bubble regime to the multibubble regime was gradual. The fraction of heating area covered by multibubbles increases with increasing heat flux and is predictable. The area fraction is a Poisson function of the product of the mean area of influence of single bubbles and the instantaneous population density. Author

N65-12309*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
APPARATUS FOR MEASURING TEMPERATURE DROP ACROSS AN INTERFACE
C. F. Smith 17 Jul. 1964 19 p
(NASA-TM-X-53091) OTS Prices: HC $1.00/MF $0.50

The apparatus and techniques used to determine the temperature drop across a bolted interface are described. The parameters studied during this experiment were specimen heat input, interface surface treatment, bolt torque, and vacuum. Determinations were made on aluminum alloys 2024-T4, 6061-T6, and Almag 35 with various finish treatments. Author

N65-12321*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
RADIANT-INTERCHANGE VIEW FACTORS AND LIMITS OF VISIBILITY FOR DIFFERENTIAL CYLINDRICAL SURFACES WITH PARALLEL GENERATING LINES
Carol J. Sotos and Norbert O. Stockman Washington, NASA, Dec. 1964 71 p refs
(NASA-TN-D-2556) OTS Prices: HC $3.00/MF $0.75

The role of the view factor in radiation heat-transfer calculations is discussed. A general formula is derived for the view factor between differential strips of finitely or infinitely long, cylindrical surfaces having parallel generating lines. A comparison between the equation for finite length and that for infinite length is given. View factors using the general formula are presented for various pairs of differential strips of six different systems of circular cylinders and planes characteristic of space-radiator fin-tube geometries. The limits of visibility from each surface to all visible surfaces of each system are also presented. Author

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Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-11177*# National Aeronautics and Space Administration, Washington, D.C.
LOOKING AHEAD IN SPACE
Hugh L. Dryden [1964] 15 p Presented at 1964 3rd Bicentennial Marshall Wood Lecture, Providence, R.I., 21 Oct. 1964

This paper relates the various prophetic statements pertaining to space travel, up to the reality of the first satellites, and also presents the current state of affairs in the exploration of space. Dr. Hugh L. Dryden closes his presentation with the outlook in future explorations of the universe by man and machines. G.G.

N65-11378*# National Aeronautics and Space Administration, Washington, D. C.
MANAGEMENT REQUIREMENTS FOR SPACE EXPLORATION
Robert C. Seamans, Jr. [1964] 9 p Presented to the Apollo Luncheon, Natl. Aeron. and Space Eng. Meeting, Sae, Los Angeles, 8 Oct. 1964

The problem of uneconomic use of human and financial resources in the space program caused by schedule slippages in R&D contracts is discussed at length. It is stated that R&D must be controlled. Some of the approaches to this desirable control are mentioned, such as the use of incentive contracts wherever possible, improved quality control, extensive environmental testing, better task specifications, and the use of sound reporting methods, such as PERT. Several specific aspects of the problem of controlling R&D programs are discussed, and Mr. Seamans' personal views of the future trends in space program contracting are given. D.E.W.

N65-11750# California U., Los Angeles Inst. of Government and Public Affairs
DEVELOPMENT OF REGIONAL INFORMATION FLOW SYSTEM
Sidney Sonenblum Dec. 1963 18 p
(MR-4)

An information system for use in regional and area planning by state and other officials is being developed. The status variables that a literature review suggests as being essential are grouped in terms of a people–property–activity classification.

These status variables are then classified in terms of their probable relevance to specific decision-making areas. Regional-growth projections are included to provide projected magnitudes of status variables, which act as an input to the evaluation of the specific programs, and also to provide indications of the type of variables that is relevant in the specific program analyses. Measurement of the identified status variables is also discussed. Tentative identification of significant research areas includes the following: (1) population characteristics, community patterns, and migration information; (2) plant-location information; (3) interregional comparative analyses; (4) measures of state income, output, transactions, etc., for benchmark year; (5) recreation planning; (6) transportation planning; (7) water-resource planning; and (8) survey of data availability. M.P.G.

N65-11866*# National Aeronautics and Space Administration, Washington, D.C.
ASTRONAUTICS AND AERONAUTICS, 1963 Chronology on Science, Technology, and Policy
1964 615 p
(NASA-SP-4004) GPO Price $2.00; OTS Price MF $3.00

This is the 1963 chronology of compilations of known events that are related to the scientific, technological, organizational, and policy aspects of space exploration and space exploitation. This volume also contains the following annexes: "Satellites, Space Probes, and Manned Space Flights—1963"; and "Major NASA Launchings 1963." G.G.

N65-12318*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RELIABILITY GROWTH OF U.S. ROCKETS AND COST/RELIABILITY RESEARCH EXECUTIVE SUMMARY REPORT
R. G. Voss 6 Nov. 1964 17 p
(NASA-TM-X-53161) OTS Prices: HC $1.00/MF $0.50

This report summarizes the results of a study investigating reliability growth and the relationship between cost and reliability. A primary objective of the study was the development of a method for estimating the reliability of future space vehicles as a function of the major characteristics of the vehicle subsystems, and for investigating the relationship between reliability and cost of space vehicles and their subsystems so that tradeoffs between these two parameters could be made. In developing a firm philosophical and mathematical foundation upon which to investigate these study areas, a significant broadening of the original goals was achieved. As a secondary objective, a complete and definitive updating and expansion of a previous study of the reliability of U.S. rockets was achieved. A reliability growth model for estimating the reliability of future space vehicles, as well as for analyzing present vehicles, was developed, and is presently operational on MSFC computational facilities. Also, a methodology was developed that will permit predictions of cost and reliability relationships for future launch vehicles if sufficient data are available. Author

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